FRESENIUS 2008K
HEMODIALYSIS SYSTEM

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TROUBLESHOOTING GUIDE
FOR TRAINING PURPOSES ONLY

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USING THE TROUBLESHOOTING GUIDE

A. It is assumed the troubleshooter is certified on 2008 K machines and knows how to use the required test equipment (see page 11).

B. Wear gloves!

C. Always perform INITIAL CHECKS (page 6) before beginning. Always perform FINAL CHECKS (page 10) when Troubleshooting is complete.

D. Procedures are arranged in 'flow chart' style that logically isolates to malfunctioning component(s). Read each procedure **THOROUGHLY** then proceed as directed. **Pay particular attention to 'Cautions' and 'Notes'.**

E. Be CAREFUL to maintain your location as you read. Missing or skipping steps will lead to error!

F. Sometimes alternate procedures are 'called'. When this occurs, **NOTE** the procedure and page number before proceeding to the 'called' procedure in case you need to return.

G. Do NOT calibrate or 'swap' parts unless instructed. If possible, return the machine to the state where the malfunction was first observed. **NEVER swap parts between malfunctioning machines!**

H. If 'possibilities' are suggested, for example: Two possibilities: 1) Bad actuator board; 2) Bad test board; swap the listed parts in one at a time, with known good, (i.e. tested) and test the machine in between for the symptom that you are troubleshooting.

I. **IMPORTANT!** ALWAYS turn the machine OFF before replacing a circuit board or unplugging ribbon cables. Observe Electrostatic Discharge (ESD) Precautions when working inside the electronic card cage!

J. Calibration may be required after replacing a component. See Appendix B (page 261).

K. Referring to Figure 1 (page 3), if (and ONLY if) asked to measure voltages or resistances with respect to ground, connect the meter's ground (black) lead to the metal card cage i.e. chassis ground.

Figure 1 – Ground Lead

L. Some procedures vary depending upon the optional DiaSafe® filter. Referring to Figure 2A (page 4), there are two types:

1. **DiaSafe® Filter Plus:** Mounted externally on the rear panel of the machine
2. **Old Style DiaSafe® Filter:** Mounted inside, on the floor of the hydraulic compartment

Continued on next page

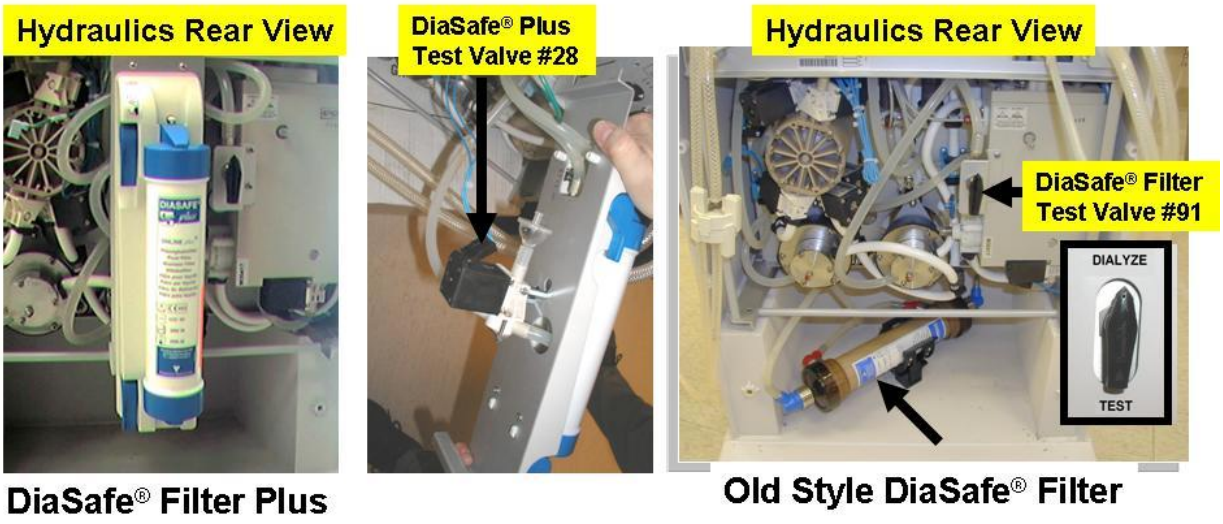


Figure 2A – DiaSafe® Filter

M. Referring to Figure 2B (page 4), some procedures vary depending if the machine is equipped with the **New Style Hydro Chamber** or **Old Style Hydro Block**.

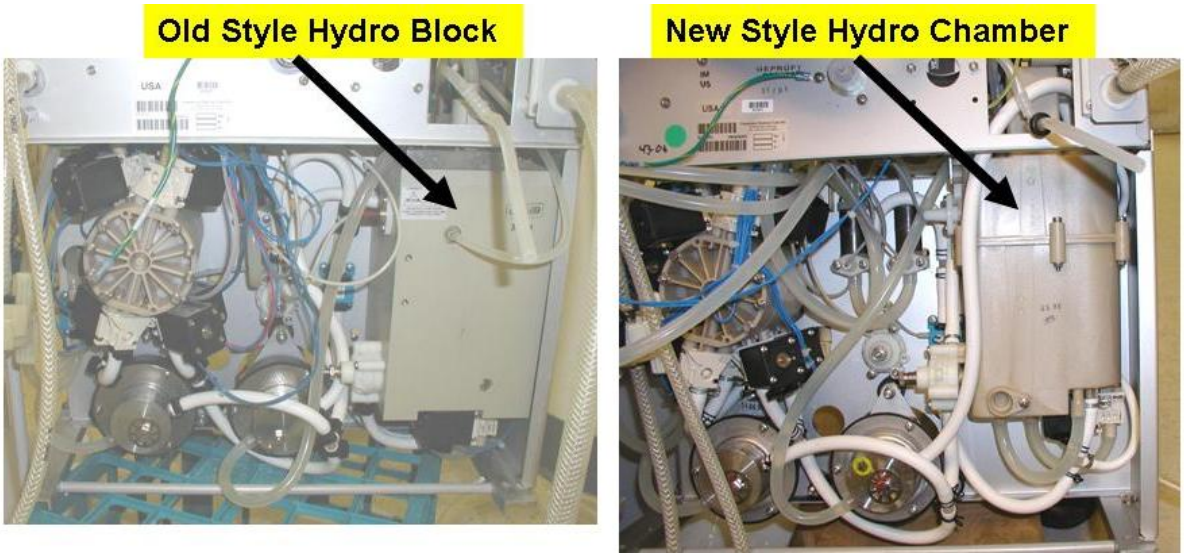


Figure 2B – Hydro Block / Hydro Chamber

N. Hydraulic components can be easily isolated via the distribution board. Referring to Figure 3 (page 5):

- The distribution board is divided into three sections: **1)** Sensors; **2)** Pumps; **3)** Valves
- Electronic hydraulic components each have a 'labeled' connector 'position' as referenced by the Flow Diagram. For example, float switch #5 plugs into position #5, labeled "FLOAT-SW". Yellow-lettered labels are printed either above or below the connector. A flashlight is helpful
- From left-to-right, positions start at #2 [NTC #2, labeled "CON-NTC"]. **There is no position #1!**
- The connector caps are numerically labeled to match the distribution board position number. When replacing a component use a Sharpie to appropriately label its cap.

Continued on next page

- When removing a connector carefully **NOTE** its position and label. There are several unused (empty) positions, **AVOID them! Be VERY CAREFUL to return connectors to their correct positions!**
- If possible, unplug only one connector at a time
- To prevent damage, turn the machine off BEFORE removing OR returning a RIBBON cable. These include the sensor, actuator, acid and bicarbonate pumps, blood leak sensor and digital heparin pump (if equipped). **RULE! If it's a RIBBON cable don't unplug it with the machine on!**
- The 5-pin female connectors can be unplugged and returned with the power on
- **THE 8-PIN HEATER CONNECTOR PRESENTS AN ELECTROCUTION HAZARD. ALWAYS TURN THE POWER OFF AND/OR UNPLUG THE MACHINE BEFORE TOUCHING IT!**

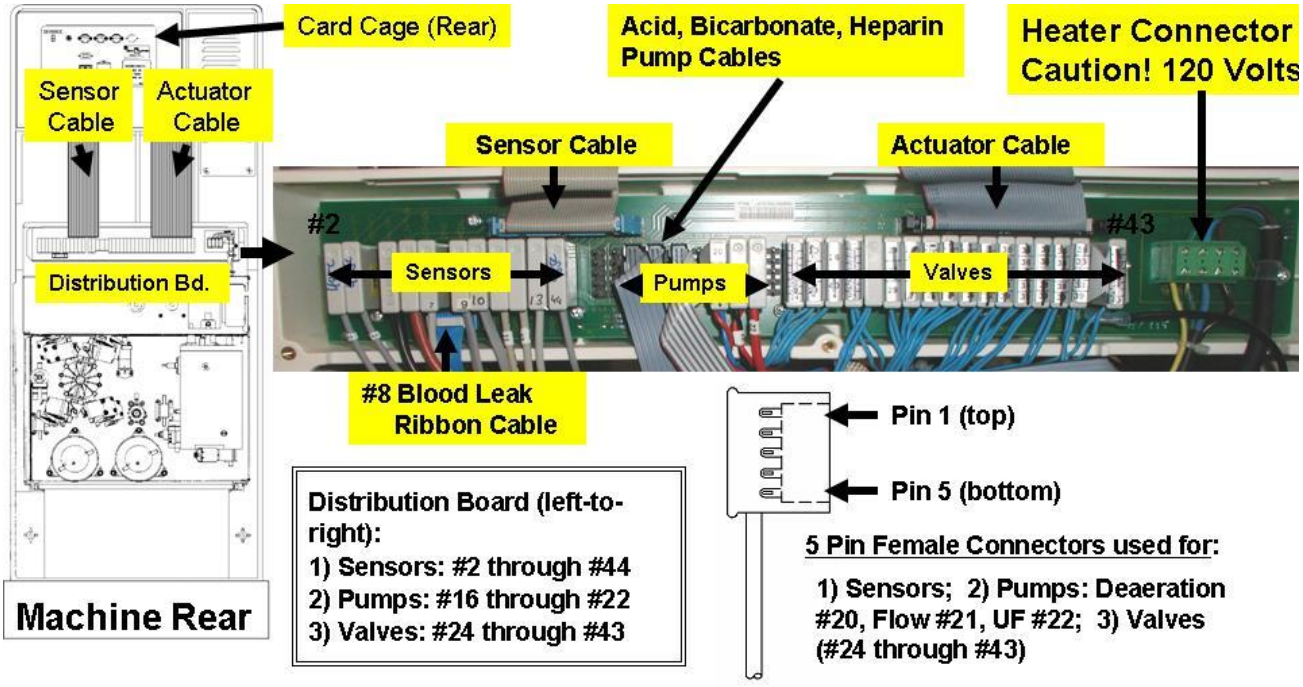


Figure 3 – Distribution Board

End of Using the Troubleshooting Guide

THE (HYDRAULIC) 'ORDER' OF TROUBLESHOOTING

Most hydraulic alarms ***cause*** other alarms. For example, a function of the 2008 K is to turn the heater off during Flow Errors. Therefore, a Flow Error also causes low Temperature. Following the 'Order of Troubleshooting' will quickly lead to the ***root cause*** of a problem and NOT its **effects**.

1. No Water
2. Flow Errors
3. Temperature
4. Conductivity
5. Filling Programs
6 TMP (Transmembrane Pressure)
7 Blood Leak
8 Pressure Test Failures

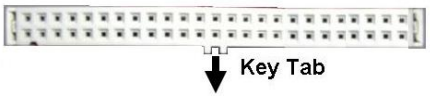
1. "No Water" alarms turn all eight balancing chamber valves and the heater off.
2. "No Water" alarms may cause FLOW ERRORS. Assure the machine is free "No Water" alarms before troubleshooting a FLOW ERROR.
3. FLOW ERRORS turn the heater off. Assure the machine is free of FLOW ERRORS before troubleshooting a low TEMPERATURE alarm.
4. CONDUCTIVITY is temperature compensated. Assure that Temperature is stable between 35.5 and 38.5° C before troubleshooting a CONDUCTIVITY alarm.
5. Air sensor #6 monitors for conductive fluid and thus low Conductivity may cause FILLING PROGRAMS. Assure that Conductivity is greater than 10.0 mS before troubleshooting FILLING PROGRAMS.
6. Valve #43 opens to drain (atmosphere) during Filling Programs and thus may cause TMP alarms. Assure the machine is free of a Filling Program before troubleshooting a TMP alarm
7. TMP alarms or Filling Programs may indicate air leaks which may cause false BLOOD LEAK alarms. If a Conductivity or Temperature alarm is present, valve #24 closes (bypass) and the BLOOD LEAK SENSOR #8 is bypassed. Assure the machine is free of all other alarms before troubleshooting a BLOOD LEAK alarm.
8. PRESSURE TESTS may fail with hydraulic alarms due to unstable flow or air. Assure the machine is free of all other alarms before troubleshooting PRESSURE TEST failures.

Refer to the TABLE OF CONTENTS to locate the symptom.

End of The Order of Troubleshooting

INITIAL CHECKS

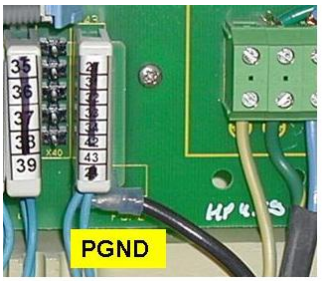
1. **IMPORTANT!** Turn the machine off to prevent damage!
2. Referring to Figure 3 (page 5), remove the distribution board panel and:
   - Assure the Sensor and Actuator cables are plugged in securely with their **key tabs down** (see Figure right).



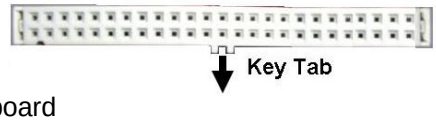
   - CAREFULLY check BOTH cables and connectors for damage. **Replace damaged cables!**
   - Assure that all five pin female connectors are plugged into their correct positions and aligned properly
   - Check the eight-pin heater connector for brown or black discoloration

Continued on next page

- Referring to the Figure (right), ASSURE the Power Ground (PGND) wire is plugged in securely
- Using a flashlight, CAREFULLY check for 'white' corrosion, especially above and below the Sensor and Actuator cables. **If corrosion is located it may be necessary to replace the distribution board**

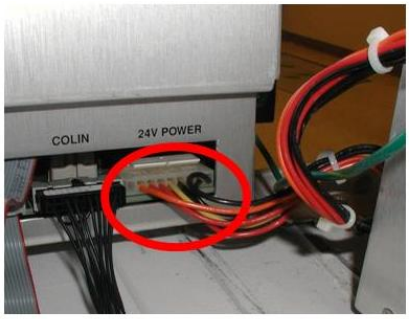


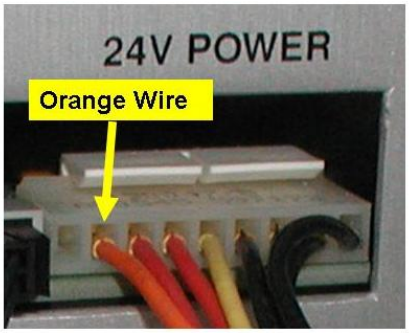
3. Remove **ALL** items from the top of the machine!
4. Open the card cage. Referring to Figure 4A (page 8):
   - Check ALL cables and connectors for damage. Assure the ribbon cables are plugged in securely with their **key tabs down** (see Figure right).



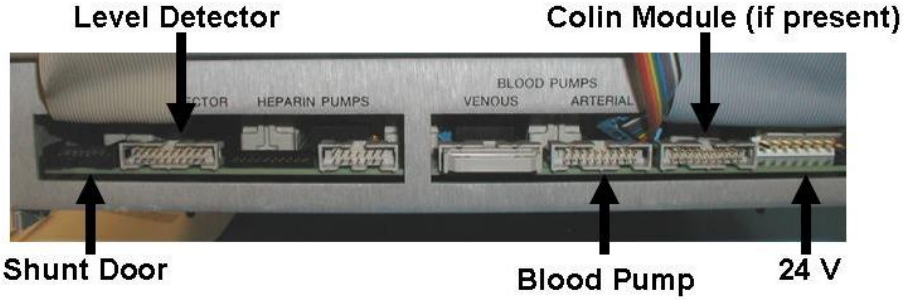
   - ASSURE all circuit boards are securely installed in their motherboard connectors. **Push each board down HARD!**
   - ASSURE all circuit boards are 'locked' in place with their front and rear 'pin locks' (see Figure right)

   - CAREFULLY investigate 'burning smells'. **A damaged motherboard or circuit board MUST be replaced!**
   - Use ESD-safe compressed air to clean dust from the motherboard
5. Referring to the Figure below, assure the **24V Power** wire harness is plugged in aligned properly (orange wire to the left) and securely.



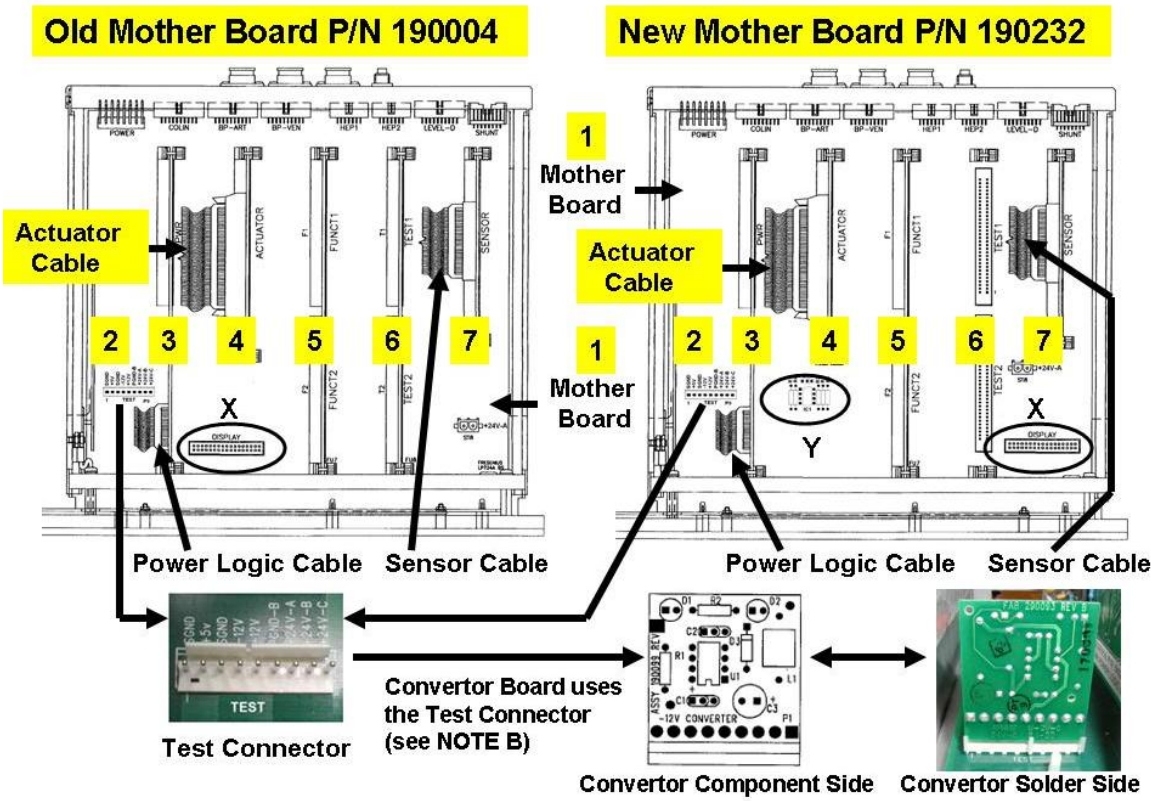


6. Referring to the Figure (below), assure all modules and the shunt door cables are plugged in securely.



7. Close the card cage. Unless otherwise instructed leave it closed!
8. **Forced Test** automatically performs Alarms and Pressure tests when all alarms are cleared. As this may cause misdiagnosis it is recommended that **Forced Test** is turned ***off*** while troubleshooting**.** Enter Service Mode → Options → Treatment Options. Set 'Forced Test' to "No". Press the 'CONFIRM' key (the "x" turns blue). Post a note as a reminder that **Forced Test** is off!

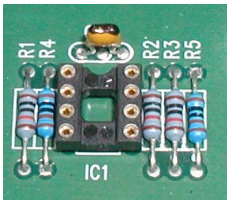
End of Initial Checks Procedures



1 – Mother Board [NOTE A]; **2** – Test Connector (9 pins); **3** – Power Logic Board [NOTE B]; **4** – Actuator or Combination Actuator/Test Board [NOTE C]; **5** – Function Board; **6** – Test Board [NOTE C]; **7** – Sensor Board

Figure 4A – Card Cage

NOTES A, B AND C:



A Machines produced in 2007 and later may be equipped with the ***New Style Motherboard***. Referring to Figure 4A (page 8), to determine which motherboard the machine is equipped with (i.e. **old** or **new style**) note the location of the DISPLAY connector (**X**). Also, the ***New Style Motherboard*** has an empty 8-pin socket (**Y**) mounted in front of the actuator board (see Figure right).

B -12 volts DC is required for the Sensor Board's conductivity circuits and the optional Internal Blood Pressure (COLIN) Module. Referring to Figure 4B (page 9), if the machine is equipped with the ***old style Power Logic Board*** a separate '+12 to -12 volt Convertor Board' is used. This miniature circuit board plugs into the motherboard's 9-pin TEST Connector (#**2**). If equipped with the ***new style Power Logic Board*** (released in 2008) the -12 volt supply is incorporated into the board and the Convertor board is NOT necessary (i.e. the TEST connector is empty). Both the ***old*** and ***new style Power Logic Boards*** are compatible with all K machines but CAUTION must be exercised. If an ***old style Power Logic Board*** is placed into a machine equipped with the ***new style Power Logic Board*** the Convertor board MUST ALSO be installed otherwise a "Cond Ref" or "Cond Offset" error occurs. If a ***new style Power Logic Board*** is placed into a machine equipped with the ***old style Power Logic Board*** the Convertor board MUST be removed!

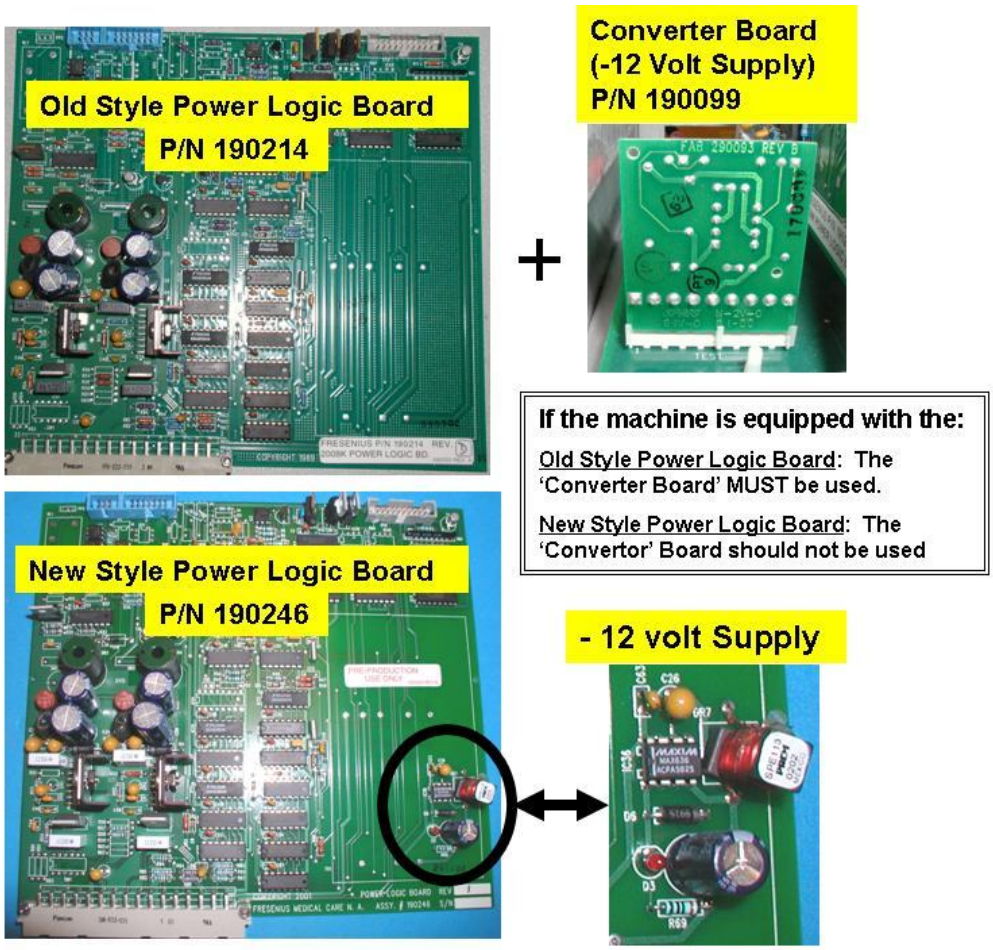

Old Style Power Logic Board
P/N 190214
Converter Board
(-12 Volt Supply)
P/N 190099
If the machine is equipped with the:
Old Style Power Logic Board: The 'Converter Board' MUST be used.
New Style Power Logic Board: The 'Convertor' Board should not be used
New Style Power Logic Board
P/N 190246
- 12 volt Supply

Figure 4B – Old / New Style Power Logic Board

C. Referring to Figure 4C (page 10), *m*achines produced in 2007 and later MAY be equipped with the **new style 'combination'** ***Actuator / Test Board***

- The Actuator / Test Board 'combine' the functions of the separate **old style Actuator** and **Test Boards** and uses motherboard slot #**4**. To use the 'combination' features the machine must be equipped with the **new style motherboard** AND Function board software must be version 3.29 or greater. A separate Test Board is not required (i.e. motherboard slot number #**6** is empty. Slot #6 may be used for future development)
- The Actuator Board / Test Board can be used as just an Actuator board with the old motherboard providing a separate Test board is ALSO installed in motherboard slot #**6** AND Function Board software is version 3.29 or greater
- If a new Actuator / Test Board is placed into the machine VOLTAGE DETECTOR CALIBRATION must be performed otherwise 5 or 12 volt alarms may occur

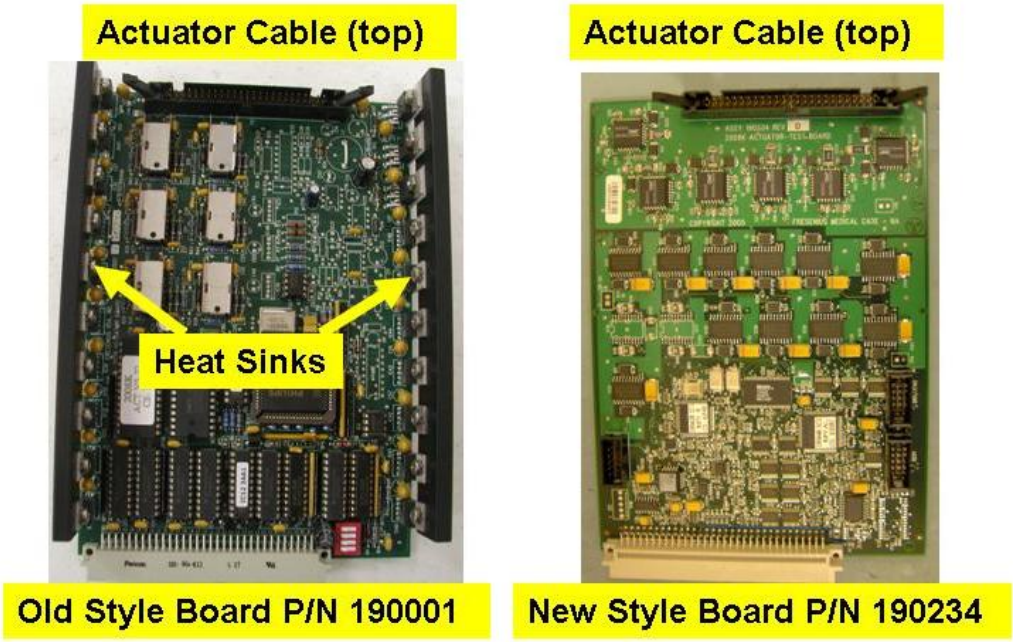


Figure 4C – Old / New Style Actuator Board

FINAL CHECKS

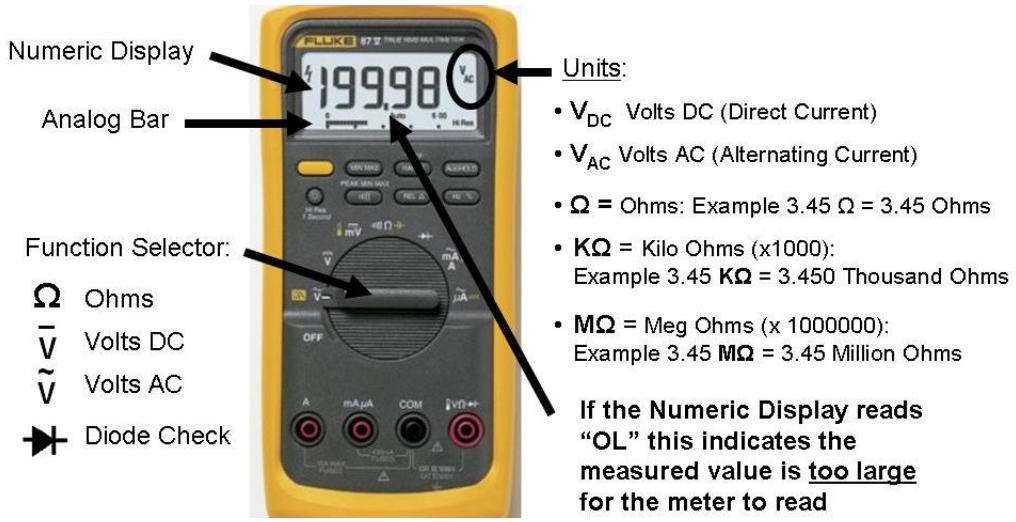
After troubleshooting and before returning the machine to clinical service:

1. Remove all test equipment from the distribution board and assure all connectors and cables are plugged in and aligned properly. Return the cover.
2. Clean ALL spills from inside the hydraulic drawer. This may be helpful to locate leaks in the future.
3. Return all panels and ASSURE the vent tubing is NOT clamped or pinched.
4. If unit policy requires **FORCED TEST** assure it is on ("Yes") from Service Mode → Options → Treatment Options.
5. Turn the machine on and assure the Audible alarm reports.
6. Check Temperature, Conductivity, and pH per Preventative Maintenance Procedures.
7. Perform the automated Alarms/Pressure Tests per Preventative Maintenance Procedures. Do **NOT** return the machine to clinical service unless all tests pass.
8. Place the acid connector into a jug of water and allow the Conductivity to fall until the Bypass LED (front panel) turns on. ASSURE there is no flow through the external flow indicator (i.e. 'bypass function').
9. Perform Acid Clean and Bleach or Heat Disinfection per unit policy.

End of Final Checks Procedures

TEST EQUIPMENT

- Digital Multimeter (Fluke® recommended!)


Numeric Display
Analog Bar
Function Selector:
Ω Ohms
V̄ Volts DC
Ṽ Volts AC
Diode Check
Units:
• V_{DC} Volts DC (Direct Current)
• V_{AC} Volts AC (Alternating Current)
• Ω = Ohms: Example 3.45 Ω = 3.45 Ohms
• KΩ = Kilo Ohms (x1000): Example 3.45 KΩ = 3.450 Thousand Ohms
• MΩ = Meg Ohms (x 1000000): Example 3.45 MΩ = 3.45 Million Ohms
If the Numeric Display reads "OL" this indicates the measured value is too large for the meter to read

- Fresenius Gauge Kit (P/N 150034)
- Resistor Test Plugs: Temperature (P/N 190060 – **four resistor set**); OLC (Online Clearance, P/N 190168 – **two resistor set**)
- One (1) 1000 ml Graduated Cylinder; One (1) 100 ml Graduated Cylinder
- One (1) 60 ml syringe
- Grounding Kit (P/N 190111) for Electrostatic Static Discharge (ESD) protection
- Flashlight
- Industrial Grade Thermometer (or a calibrated Phoenix® meter)
- Independently (and annually) Calibrated Temperature/Conductivity/Pressure Meter
- Referring to Figure 5 (page 11): **1)** *Fluke TP 80 Test Probes; 2**)** Fluke Universal Test Leads; **3)** Fluke Hook Clips; **4)** Magnetic (Mag) Probe (to check solenoid magnetism). These accessories are available for purchase from www.stanleysupplyservices.com.

  ***** TP 80 probes include a protective plastic cap to prevent shorting pins together when measuring voltages in tight areas.

Figure 5 - Fluke Meter Accessories / Mag Probe

OPERATING MODES

How to Enter Dialysis Program:

a) Plug the connector(s) into concentrate and turn the machine on. Allow the Start-Up ("Select Program") screen **(1)** to appear.

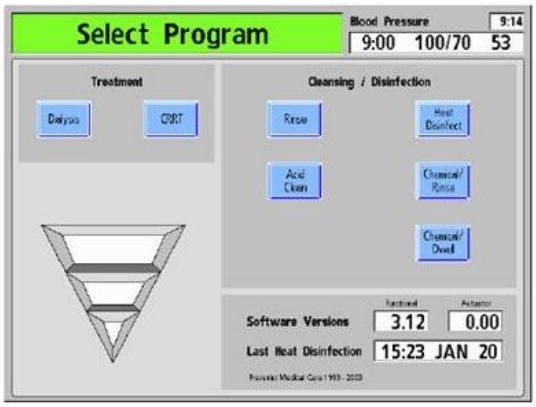
b) Select the 'Dialysis' button to call the Dialysate ("Select Concentrate") screen **(2)**.

c) Select the 'Conc' button **(2)**. A list of your concentrates appears.

d) Using the panel's arrow (or +/-) keypads, select the concentrate that is connected to the machine.

e) Press the 'CONFIRM' key. The machine is now preparing dialysate i.e. in Dialysis program.

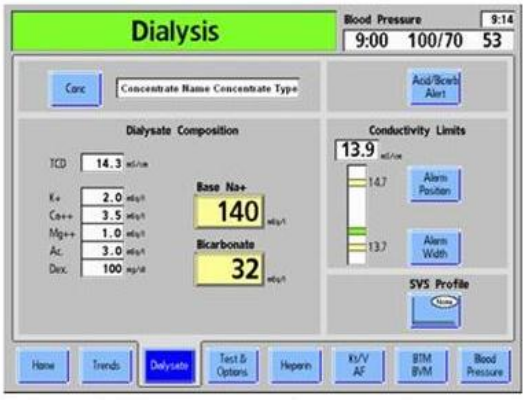
f) Select the 'Home' tab at the bottom of the screen to call the 'Home' screen **(3)**. NOTE: The "CONFIRM Concentrate" screen can be called at any time by selecting the 'Dialysate' tab at the bottom of the screen.



1) Select Program Screen

Auto flow ("a500", "a800") Function

Selecting Dialysate flow rates greater than 800 ml/min may enable the ***auto flow*** function (1.5x or 2x) depending on software. At these settings Dialysate flow rates depend on blood flow rates and the [Dialysate Flow] window displays a preceeding "a" (example "a500"). **Do NOT enable auto flow while troubleshooting!**



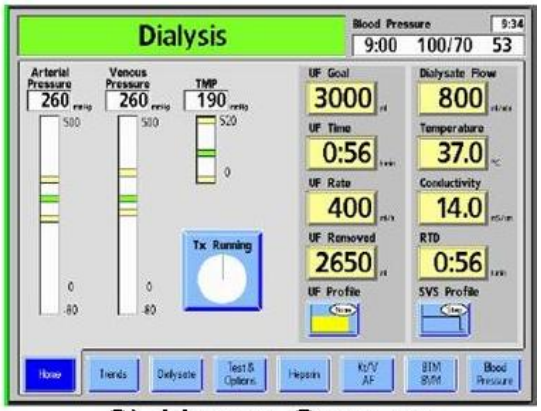
2) Select Concentrate Screen

How to Enter a Cleaning / Disinfection Program:

a) Place both dialyzer quick connectors into the shunt and close the door.

b) Place both concentrate connectors into their respective rinse ports. This calls the "Select Program" screen **(1)**.

c) Select the desired Cleaning / Disinfection Program button. K^2 machines, the button turns blue then press the 'CONFIRM' key.



3) Home Screen

How to "Enter" Service Mode:

After power on, when the "Press CONFIRM for Service Mode" message appears press the 'CONFIRM' key.

How to Enter Test and Calibration (T and C) Mode:

Swapping a sensor or function board may cause Conductivity Errors on power up. T & C defeats these errors so the boards can be tested without performing calibrations.

Enter Service Mode → Options → Hardware Options. Select "Yes" for T and C and press the 'CONFIRM' key (the 'x' turns blue). Turn the machine off, back on then enter whatever program is desired.

End of Operating Modes

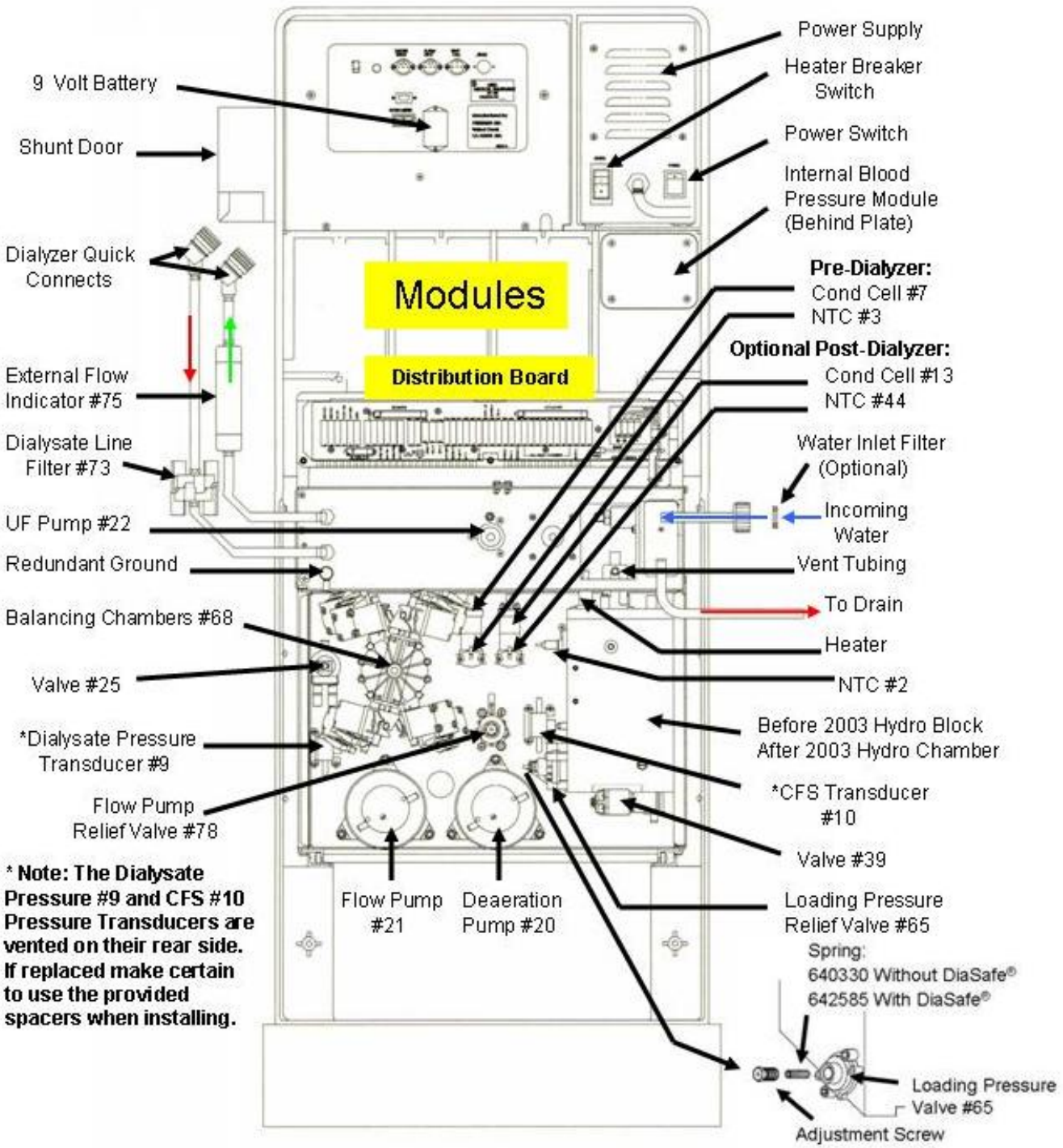


Figure 6 – Machine Rear View

SECTION 1- FLOW ERROR IN DIALYSIS PROGRAM

Perform these procedures if referred here or if Flow Error messages ("Flow Error", "Flow Inlet Error", "High Flow Error", and "Low Flow Error") are consistently occurring.

F- 1.0.0 SIMPLE FLOW CHECKS

a) Referring Figure 6 (page 13), if the vent tubing is restricted this may be the problem!

b) If the machine is equipped with the **old-style DiaSafe® filter** and 'Test Valve' (located lower rear panel) is NOT pointing to 'Dialyze' (see Figure right) this may be the problem!

c) If the drain tubing is kinked or restricted this may be the problem!

d) If the hydraulics are outside the machine and equipped with a DiaSafe® filter, 'pinched' tubing to and from the filter may be the problem!

e) If the external flow indicator (#75) is NOT vertical (see Figure right) this may be the problem!

f) Perform INITIAL CHECKS (page 6).

g) Place the machine into Dialysis Program (remember to press the 'CONFIRM' key).

h) **IMPORTANT!** If Automated Tests start (screen reads "Test …") at ANY time allow them to complete! Automated Testing, while troubleshooting, may cause misdiagnosis! IGNORE all test messages for now!

i) Is a "No Water" message (constant or intermittent) occurring?

Yes Proceed to **page 64**, SECTION 2 – NO WATER.

No See procedure number F- 1.0.1 (page 14).

IMPORTANT! While troubleshooting, if (and ONLY if) a "No Water" message presents proceed to page 59, SECTION 2 - NO WATER

F- 1.0.1 CHECK FOR EXTERNAL LEAKS

a) Assure Dialysate flow is ON (Dialysate Flow on/off LED off).

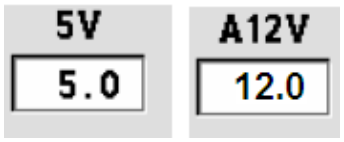
b) Referring to the Figure (right), slow dripping from the vent tubing is NORMAL with some Flow Errors. **IGNORE** it for now!

c) Check inside the hydraulic drawer and at the DiaSafe® filter (if equipped). Is a water leak located?

Yes Proceed to **page 248**, SECTION 21- LARGE HYDRAULIC LEAKS.

No See procedure number F- 1.0.2 (page 14).

F- 1.0.2 CHECK +5 AND +12 VOLT SUPPLIES



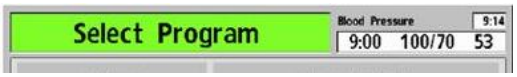
Call debug screen 4 (two checks): **1) 5V** (left column) between 4.8 and 5.2 AND stable (i.e. does not vary greater than +/- 0.1)? **2) A12V** (right column) between 11.5 and 12.5 AND stable?

Yes See procedure number F- 1.0.3 (page 15).

No Perform VOLTAGE DETECTION CALIBRATION. If (and ONLY if) unsuccessful, replace the power logic board (see Figure 4A and NOTE B, page 8). If (and ONLY if) the problem still exists (i.e. bad or unstable +12 or +5 volts) after board replacement proceed to **page** Error! Bookmark not defined., SECTION 24 – TROUBLESHOOTING POWER DISTRIBUTION

F- 1.0.3 CHECK MOTOR ACTUATOR BOARD CONTROL

a) Return the red concentrate connector to its rinse port. **Do not start a Cleaning / Disinfection program!** The "Select Program" screen MUST be up to continue!



b) Referring to Figure 7 (page 15), check BOTH the FLOW and DEAERATION motor shafts for rotation then refer to Table M (page 15).

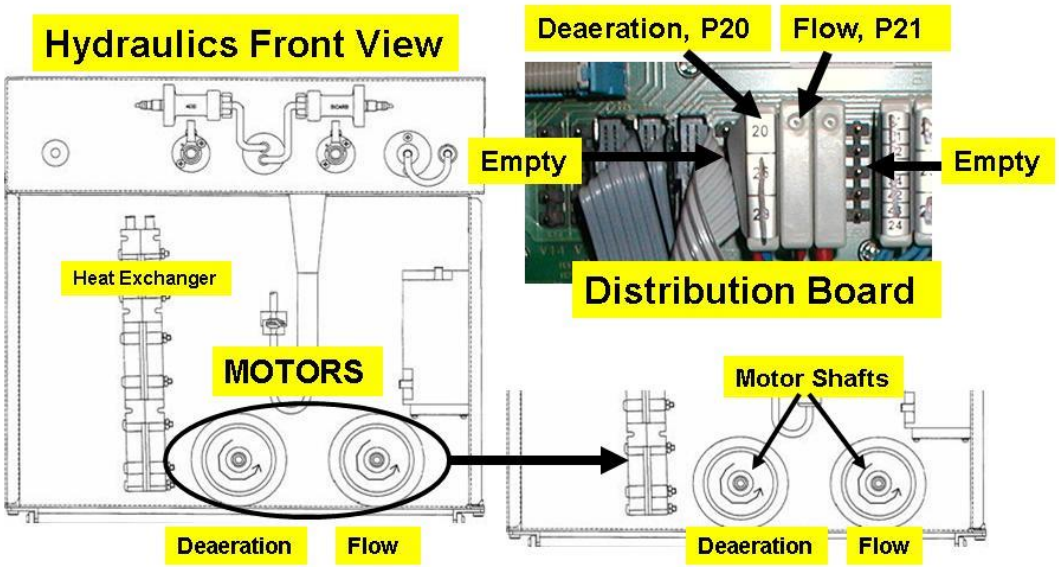


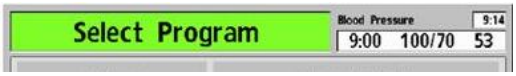
Figure 7 – Motors (Deaeration / Flow)

TABLE M – Motor Checks

Flow Motor Rotating?	Deaeration Motor Rotating?	Response
No	Yes	This is normal! See procedure number F- 1.0.5 (page 16).
No	No	**NOTE** the Deaeration Motor ONLY will be checked then proceed to **page 60**, TROUBLESHOOTING MOTORS.
Yes	**Does not matter**	See procedure number F- 1.0.4 (page 15).

F- 1.0.4 TROUBLESHOOT MOTORS

Is the "Select Program" screen up?



Yes **It is NORMAL for the deaeration motor to rotate but the flow pump should NOT be rotating!** Referring to Figure 7 **(**page 15), if (and ONLY if) the **FLOW MOTOR** is rotating**,** trace the wire harnesses of BOTH motors from the distribution board to the motors. If (and ONLY if) both motors are connected properly replace the actuator board.

No The "Select Program" screen is required! Repeat procedure number F- 1.0.3 (page 15).

F- 1.0.5 CHECK FLOW PUMP ACTUATOR BOARD CONTROL

a) Plug the red concentrate connector into concentrate. The blue connector (if using bicarbonate) should be connected to fresh bicarbonate.

b) Select the screen's 'Dialysis' button. With K^2 machines ONLY the button turns blue, then press the 'CONFIRM' key.

c) Press the 'CONFIRM' key. The machine is now in Dialysis program.

d) **IMPORTANT!** Assure Dialysate flow is ON (Dialysate Flow on/off LED off).

e) Call debug screen 1. **FLWP** (upper right) is (three scenarios):

1. **Cycling between 255 and 160:** See procedure number F- 1.0.6 (page 16).
2. **REMAINING less than 255:** See procedure number F- 1.0.6 (page 16).
3. **REMAINING 255:** Momentarily place the machine into Rinse program then repeat procedure number F- 1.0.5 (page 16). If (and ONLY if) you return here (because **FLWP** is remaining 255) two possibilities: **1)** Bad actuator board; **2**) Bad function board.

F- 1.0.6 CHECK FOR ELECTRICAL 'VALVE CIRCUIT' MALFUNCTION

From debug screen 1, is **VERR** (lower right corner) greater than 5?

Yes See procedure number F- 1.0.7 (page 16)

No See procedure number F- 1.0.8 (page 16).

F- 1.0.7 VERIFY VALVE CIRCUIT MALFUNCTION

a) Turn the machine off (to reset **VERR**) then back on.

b) Return to Dialysis program (remember to press the 'CONFIRM' key). ASSURE Dialysate Flow is ON (Dialysate Flow on/off LED off).

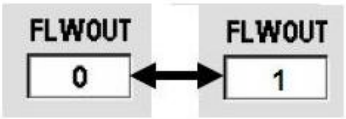
c) Call debug screen 1. Is **VERR** INCREASING at one unit per second?

Yes **NOTE** the machine is in DIALYSIS PROGRAM then proceed to page 81, TROUBLESHOOTING VALVE ERRORS.

No **VERR** is remaining less than 5. See procedure number F- 1.0.8 (page 16).

F- 1.0.8 CHECK BALANCING CHAMBER CYCLING

Call debug screen 2 and CAREFULLY watch **FLWOUT** for **40 seconds**. Is **FLWOUT** cycling between 0 and 1 (possibly every nine seconds)?



Yes See procedure number F- 1.0.9 (page 16).

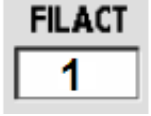
No The balancing chamber valves are NOT cycling. See procedure number F- 4.0.0 (page 23).

F- 1.0.9 CHECK FILLING PROGRAM ACTIVE (FILACT)

a) Referring to the Figure (right), UNPLUG the connector (or resistor plug*) at distribution board position labeled "AIR-SEN". This is air sensor #6.

* Other Troubleshooting Procedures may have placed a resistor plug here previously.

b) Leaving the "AIR-SEN" position EMPTY**, IMPORTANT!** ALLOW up to **30 seconds**. **FILACT** response is not instantaneous!



c) From debug screen 1, does **FILACT** = 1?

Yes See procedure number F- 2.0.0 (page 17).

No a) After 30 seconds **FILACT** remains = 0! ASSURE the air sensor's distribution board position (labeled "AIR-SEN") is EMPTY before continuing! If not, repeat procedure number F- 1.0.9 (page 16).

b) See procedure number F- 1.0.10 (page 17).

F- 1.0.10 TROUBLESHOOT FILLING PROGRAM FAILURES

Perform this procedure ONLY when the "AIR-SEN" position is EMPTY AND FILACT REMAINS = 0
NOTE: This Filling Program failure must be repaired but it may or may not fix a Flow Error!

a) Using a flashlight, check **inside** the vacant "AIR-SEN" position for 'white' corrosion or damaged **male** pins that may cause false signals.

b) With the air sensor **remaining** unplugged, four possibilities: 1) Bad sensor board [a]; 2) Bad function board [b]; 3) Bad distribution board; 4) Bad motherboard.

[a] Swap in a known good sensor board (see Figure 4A, page 8). Enter Service Mode → Options → Hardware Options. Set T and C (Test and Calibration) to "Yes". Press the 'CONFIRM' key (the "x" turns blue). From debug screen 1, if **FILACT** = 1 the previous sensor board is bad.

[b] Swap in a known good function board (see Figure 4A, page 8). Assure that EEPROM (IC2) is installed. Place the new function board into T and C. From debug screen 1, if **FILACT** = 1 the previous function board is bad.

F- 2.0.0 CHECK VALVE #43 ELECTRICAL PROBLEM (VERR)

a) **IMPORTANT!** Open the shunt door and leave it open until instructed otherwise!

b) From debug screen 1, is **VERR** greater than 5?

Yes **NOTE** that **Valve #43** is causing a Valve Error and proceed to **page 84**, procedure number **VE- 2.0.0**.

No See procedure number F- 2.0.1 (page 17).

F- 2.0.1 ISOLATE FILLING PROGRAM / CHECK BALANCING CHAMBER CYCLING

a) Referring to the Figure (right), CAREFULLY place one of the resistor plugs, from the four-resistor Temperature set, into the air sensor's vacant distribution board position (**labeled "AIR-SEN"**).

b) Place a venous 'dummy chamber' in the Level Detector.

c) Allow up to 30 seconds. From debug screen 1, if the resistor plug was placed correctly **FILACT** = 0 constant.

d) Press and release the 'RESET' key then immediately press and hold it for three seconds.

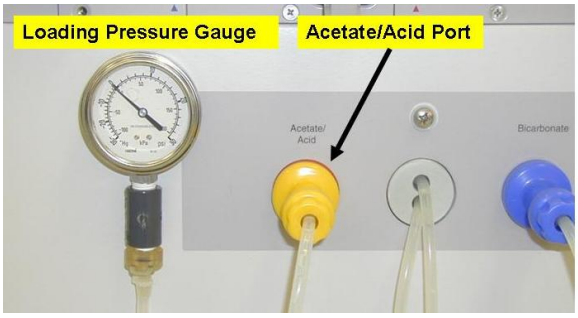
e) **IMPORTANT!** ASSURE the Air Detector alarm resets i.e. the red LED is OFF (see Figure right). This is necessary to see other alarms.

f) Is a TMP alarm present?

Yes Press and release the 'RESET' key then immediately press and hold it for three seconds. Allow the "Adjusting TMP" message to expire. If a TMP alarm returns repeat the RESET sequence up to twice more then see procedure number F- 2.0.3 (page 18).

No See procedure number F- 2.0.3 (page 18).

F- 2.0.3 CHECK LOADING PRESSURE



a) **Do NOT adjust Loading Pressure until instructed!**

b) Assuring the loading pressure gauge reads 0 psi before inserting, **SLAM** it into the red Acetate/Acid rinse port.

c) Referring Table 1 (page 18), watch CAREFULLY for two minutes. Loading Pressure is (two scenarios):

1) **Cycling (possibly every nine seconds):** Loading Pressure is 'okay' if (and ONLY if) it cycles between its maximum and to NEVER LOWER than its minimum. Continue to part d.

2) **NOT cycling:** Loading Pressure is 'okay' if (and ONLY if) it remains in the maximum range. It is NOT 'okay' if pressure is below the minimum or above the maximum. Continue to part d.

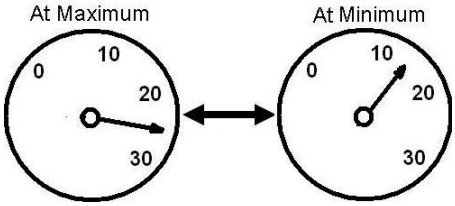
d) Is Loading Pressure 'okay'?

Yes Leaving the gauge installed see procedure number F- 2.0.6 (page 19).

No See procedure number F- 2.0.4 (page 18).

Table 1 – Loading Pressure Levels

DiaSafe® Filter?	Maximum	No lower than:
Yes	23 – 27 psi	15 psi
No	17 – 23 psi	11 psi



F- 2.0.4 VERIFY LOADING PRESSURE PROBLEM

Proceed according to the measured loading pressure (four scenarios, per Table 1, page 18):

1) **Remains less than 15 psi (with DiaSafe®); 10 psi (without DiaSafe®):** ASSURE the gauge is **slammed hard** into the rinse port! If it is see procedure number F- 15.0.0 (page 53).

2) **Cycles to OR remains higher than maximum:** See procedure number F- 2.0.5 (page 19).

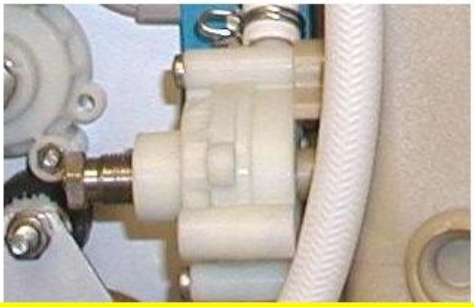
3) **Cycles to its maximum but, possibly ONLY occasionally, to below minimum:** See procedure number F- 15.0.0 (page 53).

4) **Cycles to greater than 15 psi (with DiaSafe®); 10 psi (without DiaSafe®) but does NOT reach its maximum:**

a) ASSURE the gauge is **slammed hard** into the rinse port!

b) Referring to Figure 6 (page 13), adjust loading pressure valve #65's screw* clockwise until maximum is achieved but no more than three turns!

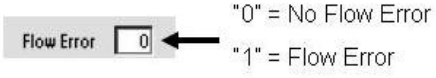
* Referring to the Figure (right), if the machine is DiaSafe® equipped, several threads should be visible. If the screw has to be turned more than three times or if the threads are NOT visible see procedure number F- 15.0.0 (page 53).


Loading Pressure Valve #65

c) Does loading pressure MAXIMUM remain low?

Yes See procedure number F- 15.0.0 (page 53).

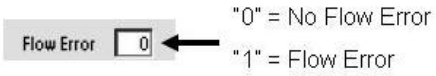
No Allow 45 seconds then call debug screen 0. If (and ONLY if) **Flow Error** = 1 (constant or intermittent) see procedure number F- 2.0.6 (page 19).



F- 2.0.5 TROUBLESHOOT HIGH LOADING PRESSURE

Referring to Figure 6 (page 13), adjust loading pressure valve #65's screw counterclockwise but no more than five turns. Does pressure adjust to its specified maximum per Table 1 (page 18)?

Yes Allow 45 seconds then call debug screen 0. If (and ONLY if) **Flow Error** = 1 (constant or intermittent) see procedure number F- 2.0.6 (page 19).



No Remove valve #65 from the hydro block/ hydro chamber and check for debris***** at the valve port.

***** Debris may indicate: A) **Old style hydro block ONLY:** 1) 'Rod baffle' degradation in chamber E (see Figure 28, page 59); 2) Excessive o-ring lubrication at the restrictor o-rings; 3) O-ring debris (if the restrictor o-rings are/were broken). B) **New Style hydro chamber AND Old Style hydro block:** 1) Inadequate acid clean cycles (causing excessive bicarbonate precipitate); 2) inadequately filtered incoming water.

NOTE (Loading Pressure): The deaeration pump creates loading pressure and can be easily heard. It should run at a constant speed (i.e. tone). If it 'stalls' its tone decreases indicating a bad motor or brushes. In this event, loading pressure falls below minimum resulting in a "Flow Inlet Error" and/or "Low Flow Error" and/or "High Flow Error" message! A bad float causes similar symptoms!

F- 2.0.6 CHECK FLOW MOTOR ROTATION

Referring to Figure 7 (page 15), **IMPORTANT**, is the Flow motor shaft rotating in the same direction as the deaeration motor (i.e. **counterclockwise**)?

Yes See procedure number F- 2.0.8 (page 19).

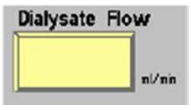
No **NOTE** the **FLOW MOTOR** ONLY will be checked then proceed to **page 60**, TROUBLESHOOTING MOTORS.

F- 2.0.8 ISOLATE THE 'IN BYPASS' CIRCUIT / CHECK FLOW STABILITY

With the shunt door OPEN:

a) Call debug screen 1. If **NPHT** is less than 600 press and hold the "1" numeric keypad until **NPHT** is greater than 600. **Ignore an "On Line PHT Failed" message if it occurs**.

b) Call the Home screen. **NOTE** the **selected** Dialysate Flow rate. ASSURE it is NOT set to "a300", "a500" or "a800". **IMPORTANT!** If Dialysate flow rate is or was changed allow three minutes for stabilization. **If flow is manually changed remember to press the 'CONFIRM' key.**



= 300, 500 or 800 ml/min

c) **IMPORTANT!** Do NOT reset alarms!

d) Call debug screen 6 and CAREFULLY watch **BC Switch** for one minute. Referring to Table P (page 20), is **BC Switch** remaining between the indicated times for the NOTED **selected flow rate**?

Yes The 'In Bypass' circuit is okay. See procedure number F- 3.0.0 (page 20).

No a) Call the Home screen and check the selected flow rate. It may have defaulted to a different rate other than what was noted above (idle flow option). If (and ONLY if) flow rate has changed repeat procedure number F- 2.0.8 (page 19).

b) There is a problem with the 'In Bypass' circuit. See procedure number F- 5.0.0 (page 25).

TABLE P

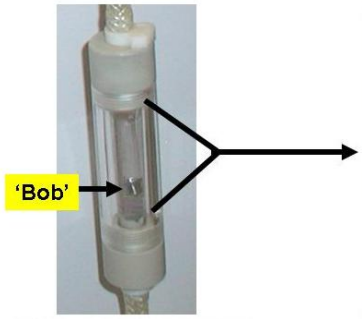
If NOTED selected Dialysate Flow rate is:	BC Switch between:
300 ml/min	540 and 660 (5.40 and 6.60 seconds)
500 ml/min	324 and 396 (3.24 and 3.96 seconds)
800 ml/min	203 and 248 (2.03 and 2.48 seconds)

F- 3.0.0 CHECK 'OUT OF BYPASS' CIRCUIT

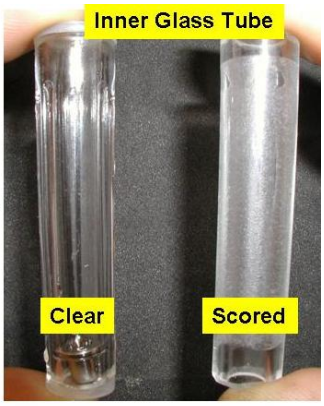
a) Close the shunt door.

b) Plug the concentrate connectors into their respective rinse ports.

c) Referring to the Figure (right), check the external flow indicator (#75) for scoring (inner tube appears cloudy) that may restrict flow. Normally the tube is very clear. **If (and ONLY if) scoring is located repair or replace the flow indicator as this may be the problem!**



External Flow Indicator



d) Place the machine into Rinse Program.

e) Is the external flow indicator's (#75) 'bob' rising, **at least ½ way up,** and falling?

Yes See procedure number F- 3.1.0 (page 20).

No See procedure number F- 14.0.2 (page 49).

F- 3.1.0 CHECK VALVE #24 / VALVE#26

a) Allow rinse to continue for two full minutes.

b) Press the 'Escape' key then the 'CONFIRM' key twice to return to the "Select Program" screen.

c) Connect to concentrate and return to Dialysis program (remember to press the 'CONFIRM' key).

d) From the Home screen, set Dialysate flow to 800 ml/min and press the 'CONFIRM' key.

e) **IMPORTANT!** With the Bypass LED ON **CONSTANT** is the flow indicator's 'bob' rising and falling?

Yes See procedure number F- 14.0.9 (page 51).

No a) Re-check loading pressure. If (and ONLY if) it is NOT 'okay' (per Table 1, page 18) return to procedure number F- 2.0.4 (page 18).

b) See procedure number F- 3.2.0 (page 20).

F- 3.2.0 CHECK DIALYSATE PRESSURE TRANSDUCER (#9)

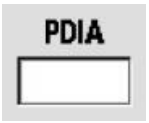
a) Referring to the Figure (right), ASSURE the dialyzer connectors are placed correctly.

b) **IMPORTANT!** Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks).

c) Remove the red connector and hang it over the dialyzer holder.

d) **IMPORTANT!** Close the shunt door. Ignore "Emptying" related messages.

e) Call debug screen 4. Is **PDIA** (left column) remaining between 4.0 and 6.0?

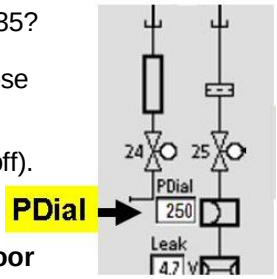


Yes See procedure number F- 3.3 0 (page 21).

No Proceed to **page 184**, procedure number **TMP- 2.1.0**.

F- 3.3.0 CHECK PDial

Call debug screen 0. Referring to the Figure (right), does the **PDIal** window read 0 +/- 35?



Yes a) **IMPORTANT!** Return the red dialyzer connector to the shunt and close the door.

b) **IMPORTANT!** Turn Dialysate Flow ON (Dialysate Flow on/off LED off).

c) See procedure number F- 3.4.0 (page 21).

No a) ACCURATELY calibrate DIALYSATE PRESSURE. **Close the shunt door when instructed per written procedure in the Calibration book!**

b) Return the dialyzer connectors to the shunt and close the door.

c) Connect to concentrate and place the machine into Dialysis program (remember to press the 'CONFIRM' key).

d) See procedure number F- 3.4.0 (page 21).

F- 3.4.0 CHECK VALVE #43 FLOW TO DRAIN

In Filling Program all flow goes through valve #43. A 1000 ml graduated cylinder is required:

a) Referring to the Figure (right), unplug the connector (or resistor plug*) at distribution board position labeled "AIR-SEN" but do **NOT** return the air sensor connector until instructed.

* Other Troubleshooting Procedures may have placed a resistor plug here previously.

b) Allow 30 seconds then call debug screen 1.

c) **IMPORTANT!** ASSURE **FILACT** = 1 constant (i.e. Filling Program active).

d) Referring to the Figure (right), at the far end of the machine's drain tubing, if a 'Quick Connector' is present, an **adaptor** IS required to allow flow. Another option is to remove the 'Quick Connector' completely.

e) **IMPORTANT!** ASSURE Dialysate flow is ON (Dialysate Flow on/off LED off)!

f) **IMPORTANT!** Do NOT reset alarms!

g) Accurately measure flow for one minute into a 1000 ml graduated cylinder. Two measurements are recommended especially if the first is low. 250 ml or greater?

Yes See procedure number F- 3.6.0 (page 22).

No a) ASSURE **FILACT** = 1 (constant)! If (and ONLY if) **FILACT** does not = 1 repeat procedure number F- 3.4.0 (page 21).

b) If (and ONLY if) the Dialysate flow on/off LED is blinking repeat procedure number F- 3.4.0 (page 21) from part e.

c) See procedure number F- 3.5.0 (page 22).

F- 3.5.0 ISOLATE ACTUATOR BOARD / VALVE #43

This procedure isolates between the actuator board and valve #43. Distribution board position "AIR-SEN" should remain EMPTY (i.e. **FILACT** = 1) for now:

a) Referring to Figure 310 (page 22), using a flashlight, check through the output tubing at valve #43 for restrictions (possibly white or clear 'bio-growth'). **If a restriction is located this is the problem!**

b) **IMPORTANT!** Allow four minutes for valve #43's solenoid to become warm (if the actuator board is okay). After four minutes CAREFULLY touch valve #43's (black) solenoid. Is it warm (i.e. energized)?

Yes The actuator board is okay. Replace valve #43 (it is not opening).

No **NOTE** that VALVE #43 (ONLY) will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

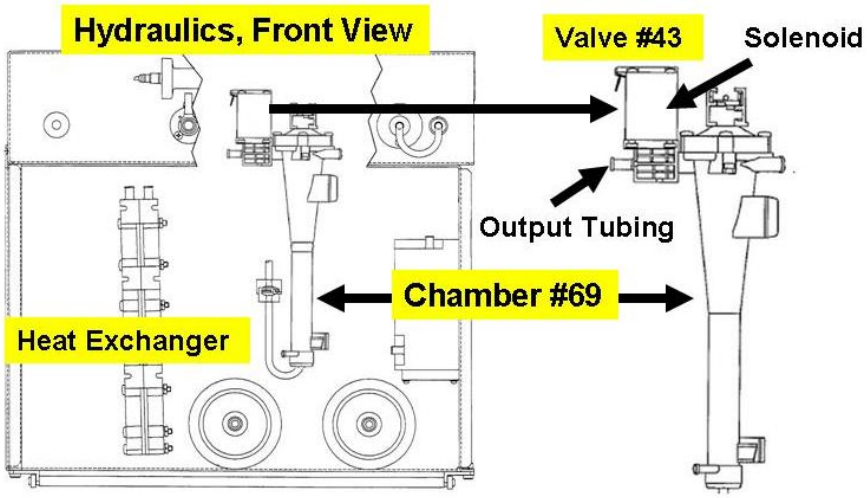


Figure 310 – Valve #43

F- 3.6.0 CHECK DIALYSATE PRESSURE TRANSDUCER

The dialysate pressure transducer (#9) senses flow in Filling Program. This procedure checks its response. Distribution board position "AIR-SEN" should remain EMPTY (i.e. screen 1, **FILACT** = 1) for now:

Call debug screen 0. Is the **PDial** window varying drastically up and down sometimes showing positive (+) values?

Yes See procedure number F- 3.7.0 (page 22).

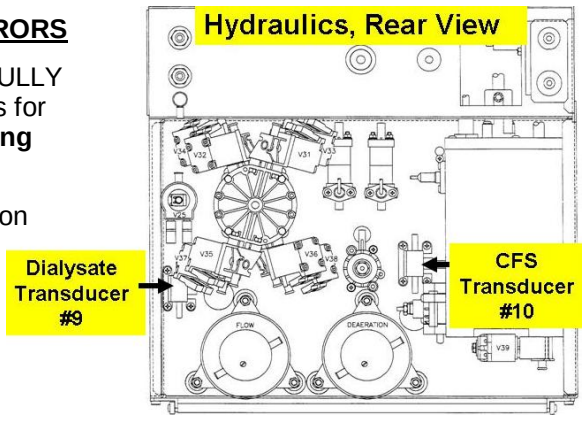
No Dialysate pressure transducer #9 is bad (see Figure 70, page 185).

F- 3.7.0 TROUBLESHOOTING INTERMITTENT FLOW ERRORS

a) Referring to the Figure (right), using a flashlight, CAREFULLY check the (blue) CFS and dialysate pressure transducers for signs of (rust colored) external leakage. **Replace a leaking transducer as this may be the problem!**

b) CAREFULLY return the air sensor connector to distribution board position "AIR-SEN".

c) Allow 30 seconds. Call debug screen 1 and assure **FILACT** = 0 constant indicating the air sensor is plugged in correctly.



Continued on next page!

d) Call debug screen 0. If (and ONLY if) **Flow Error** = 1 constant see procedure number F- 1.0.3 (page 15).

e) Press and release the 'RESET' key then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. **Ignore temporary Flow Errors during reset!**

f) If a TMP alarm occurs repeat the RESET sequence up to twice more. If (and ONLY if) the TMP alarm returns after two reset attempts proceed to **page 181**, procedure number **TMP- 1.0.16**.

g) Assuming all procedures were performed correctly the Troubleshooting Guide is unable to locate an immediate problem. The Flow Error (assuming that you saw a Flow Error) is intermittent. The following steps may help.

h) Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks). Call debug screen 10. If **ACFS** is NOT remaining between 4.0 and 5.5 the CFS transducer #10 may be intermittent bad (see Figure 21, page 43).

i) Turn Dialysate flow ON (Dialysate Flow on/off LED off) and watch loading pressure for several minutes. If the deaeration pump is stalling or if the float switch is intermittent bad loading pressure falls below the minimum and/or a "Flow Inlet Error" and/or a "High Flow Error" message appears. ALSO continue to keep an eye on **ACFS** (screen 10) if it drops to and REMAINS less than 2.0 for longer than two seconds it may be intermittent bad.

j) **NOTE** this procedure and page number in case you need to return here.

k) From the Home screen, if TMP varies greater than +/- 60 mmHg in three minutes **NOTE** nine leak tests will be performed: **1)** IOS; **2)** Balancing Chamber Valves #31 through #38. See SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

l) If a leak is not located, perform SECTION 19 - TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM (page 238).

m) "High Flow Error" **AND** Conductivity greater than 16.5 mS may be due to s stuck closed balancing chamber valve. Procedure number F- 7.0.2 (page 33) may help.

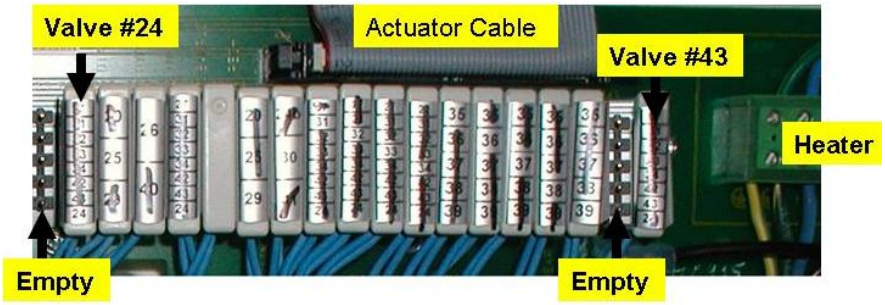
F- 4.0.0 CHECK VALVE #24 AND #43

a) **IMPORTANT!** If not already done perform INITIAL CHECKS (page 6).

b) Referring to the Figure (below), look CAREFULLY. Are valves #24 AND #43 plugged into their correct distribution board positions?

Yes See procedure number F- 4.1.0 (page 23).

No **IMPORTANT!** See procedure number F- 4.1.0 (page 23).



F- 4.1.0 VERIFY FLWOUT

ASSURING that valves #24 AND #43 are plugged in correctly:

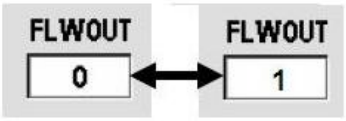
a) **IMPORTANT!** Turn the machine off then back on.

b) Return to Dialysis program (remember to press the 'CONFIRM' key).

c) ASSURE Dialysate flow in ON (Dialysate Flow on/off LED off).

d) Allow 20 seconds then call debug screen 1. ASSURE **VERR** is remaining less than 5.

e) Call debug screen 2. Watch **FLWOUT** CAREFULLY for 45 seconds. Is it cycling between 1 and 0 now?

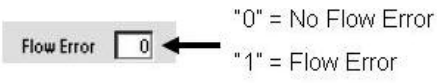


Yes See procedure number F- 4.2.0 (page 24).

No See procedure number F- 4.3.0 (page 24).

F- 4.2.0 CHECK FLOW ERROR

Call debug screen 0 and watch **Flow Error** for two minutes or until if **Flow Error** = 1. Proceed accordingly:



- **Flow Error = 1 (constant or intermittent):** Return to procedure number F- 1.0.3 (page 15).
- **Flow Error = 0 (constant):** A Flow problem is not present. Do not continue at this time.

F- 4.3.0 CHECK SOLENOID RESISTANCE (Ω)

a) CAREFULLY trace the blue wire harnesses from valve #24 AND #43 to the valve's (black) solenoid. See Figure 35 A (page 79) to locate valve #24; Figure 35 B (page 79) to locate valve #43. Two checks:

1) ASSURE the harnesses are NOT 'pinched' against the rear hydraulic panel. **If the harnesses are 'pinched' and/or damaged this may be the problem!**

2) ASSURE both harnesses are plugged into the solenoid terminals. **If not plugged in this is the problem!**

b) **IMPORTANT!** Turn the machine off!

c) Open the card cage and place an ohm (Ω) meter's lead at chassis ground (see Figure 1, page 3).

d) Referring to Figure 8 (page 24), at the top of the actuator board is a large connector (P2). The solder (rear) side pins are arranged in two rows. Odd numbered in the bottom row, even numbered in the top.

e) CAREFULLY measure resistance at the solder (rear) side of the P2 connector (two measurements):

1. ***Pin #46*** (TOP row, *third pin* from the FRONT of the machine) = **valve #43**
2. ***Pin #29*** (BOTTOM row, *eleventh pin* from the FRONT of the machine) = **valve #24**

f) Is the meter's numeric AND units display for both measurements indicating between 40 and 100 **Ω**?

Yes Two possibilities: 1) Bad actuator board; 2) Bad function board.

No **NOTE** which valve(s) is exhibiting bad resistance then see procedure number F- 4.4.0 (page 25).

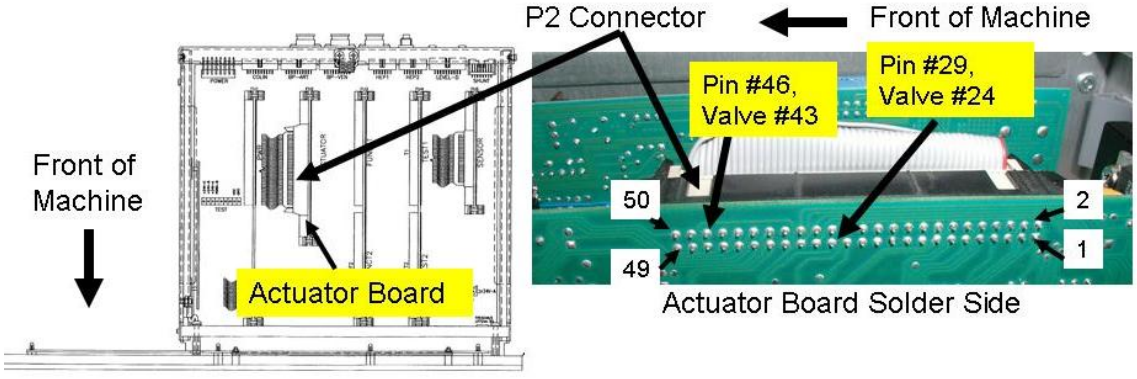
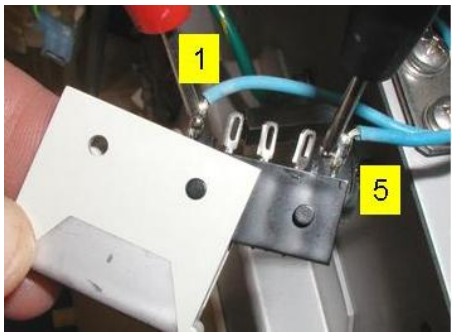


Figure 8 – Checking Solenoid Resistances (V43, V24)

F- 4.4.0 CHECK THE 'NOTED' VALVE



a) Turn the machine off.

b) Unplug the NOTED valve(s) from the distribution board position labeled "V24" or "P24" = valve #24; "V43" or "P43" = valve #43.

c) Referring to the Figure (right), open the female distribution board connector. Assure the wires are well soldered between **pins 1 and 5** (top and bottom).

d) Measure resistance (Ω), inside the female connector, between the two wires.

e) Is the meter's numeric AND units display indicating between 40 and 100 **Ω**?

Yes Two possibilities: 1) Bad actuator cable (see Figure 4A, page 8); 2) Bad distribution board.

No Replace the valve AND its blue wiring harness.

F- 5.0.0 CHECK FLOW PROBLEM

With the shunt door open, from debug screen 6, is **BC Switch** = 897 constant?

Yes See F- 5.1.0 (page 25).

No Close the shunt door and see F- 5.2.0 (page 25).

F- 5.1.0 CHECK 'IN BYPASS' CIRCUIT

a) Call the Home screen.

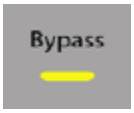
b) Set Dialysate flow to 800 ml/min (NOT "a800").

c) **IMPORTANT!** Close the shunt door.

d) Press and release the 'RESET' key then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. If a TMP alarm occurs attempt the RESET sequence up to two more times then continue.

e) Do NOT reset alarms again until instructed!

f) With the Bypass LED (front panel) ON constant, is the 'bob' inside the external flow indicator (#75) moving up and down?



Yes See procedure number F- 14.0.9 (page 51).

No See F- 5.2.0 (page 25).

F- 5.2.0 CHECK BALANCING CHAMBER VALVE CONNECTIONS

a) **IMPORTANT!** ASSURE Dialysate flow REMAINS ON (Dialysate Flow on/off LED off)!

b) Parts c through e check valve wiring. This especially important if the machine was previously worked on by someone who may have connected them incorrectly. If **absolutely sure** the machine was not worked on previously see procedure number F- 6.0.0 (page 26) otherwise it's HIGHLY recommended to perform parts c through e.

c) Referring to Figure 9 (page 26), ASSURE that all valves are plugged into their proper distribution board locations.

d) CAREFULLY trace the blue wiring harness from each valve's distribution board connector to their (black) solenoids. **Wiring harness tie wraps may have to be removed!**

e) If (and ONLY if) a wiring error is NOT located see procedure number F- 6.0.0 (page 26).

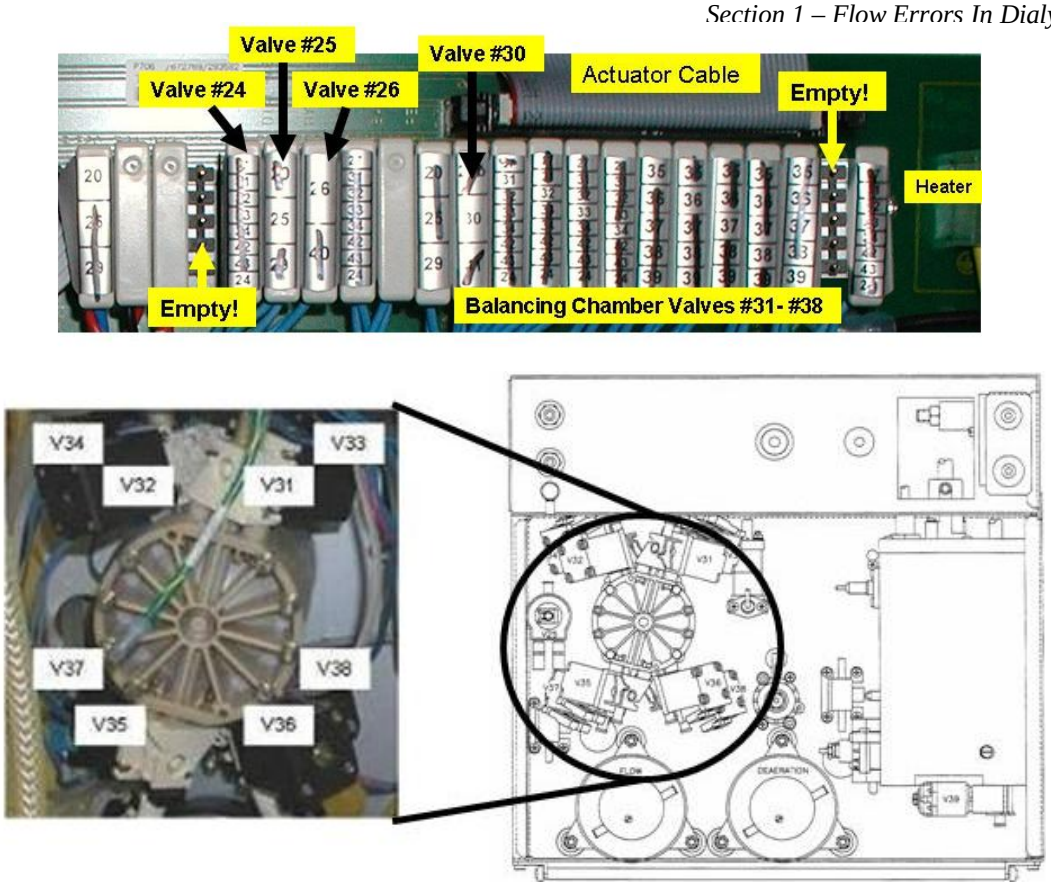
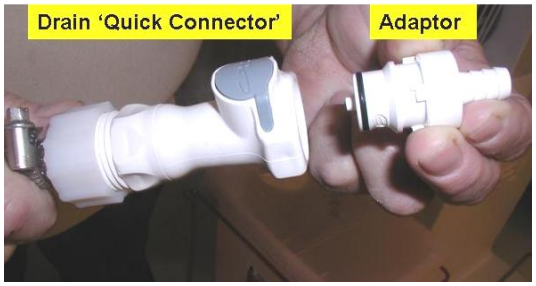


Figure 9 – Distribution Board / Balancing Chambers

F- 6.0.0 DRAIN FLOW CHECKS

CAUTION! Drain Flow checks WILL lead to error if the following instructions are ignored!



a) **IMPORTANT!** Turn Dialysate flow off (Dialysate Flow on/off LED blinks).

b) Referring to the Figure (right), at the end of the machine's drain tubing if a 'Quick Connector' is present, an **adaptor** IS required to allow flow.

c) **IMPORTANT!** Turn Dialysate flow ON (Dialysate Flow on/off LED off).

d) Referring to the Figure (right), hold the drain tube opening **UP** at approximately 45° **AND** no **higher** than three feet above the floor (to defeat gravity and residual flow)!

e) **Allow 30 seconds for flow to reach equilibrium!**

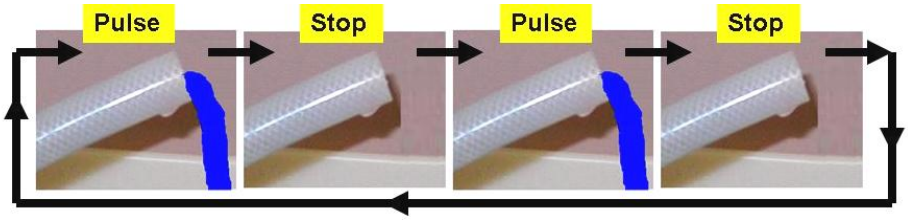
f) Observe drain flow for one minute. It will closely (if not exactly) match one of four scenarios.

g) **IMPORTANT!** CAREFULLY consider ALL FOUR scenarios (next page) and respond accordingly:

***Scenario #1*:** ***See Figure A*. If (and ONLY if) OBSERVED drain flow = EVEN, CONSISTENT, 2 second pulses that stop completely between each and every cycle. Pulses MAY occur every nine seconds:**

See procedure number F- 6.1.0 (page 28).

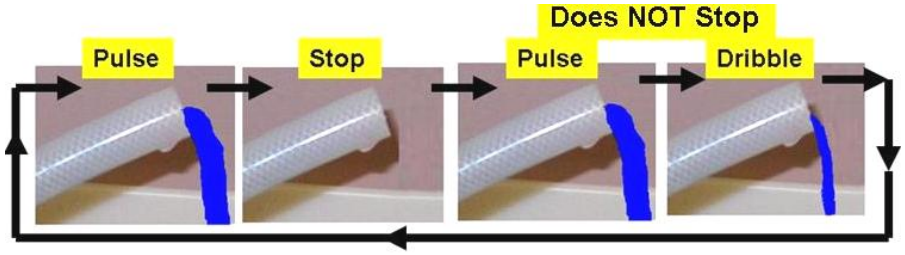
Figure A



***Scenario #2*:** ***See Figure B*. If (and ONLY if) OBSERVED drain flow = Pulse → Stop → Pulse → 'Dribble' (a noticeably weaker or uneven (greater than 2 second) stream) → etc. Flow may NOT stop completely between each cycle (i.e. inconsistent):**

See procedure number F- 6.1.0 (page 28).

Figure B

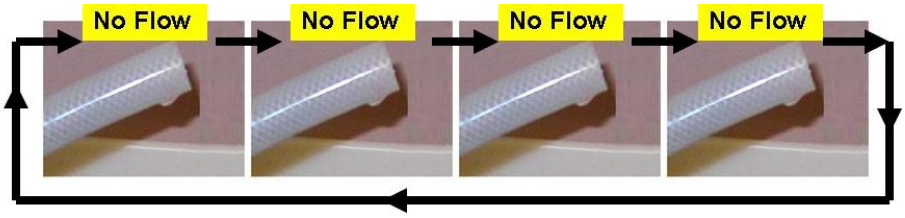


***Scenario #3*:** ***See Figure C*. If (and ONLY if) OBSERVED drain flow = No Flow EVER:**

a) If (and ONLY if) the Dialysate Flow on/off LED is blinking repeat procedure number F- 6.0.0 (page 26) from part c.

b) See procedure number F- 6.2.0 (page 29).

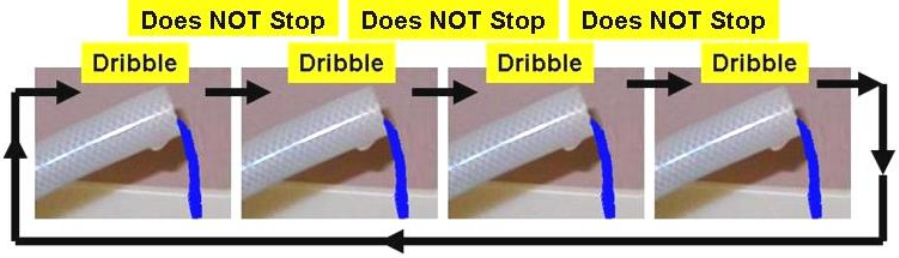
Figure C



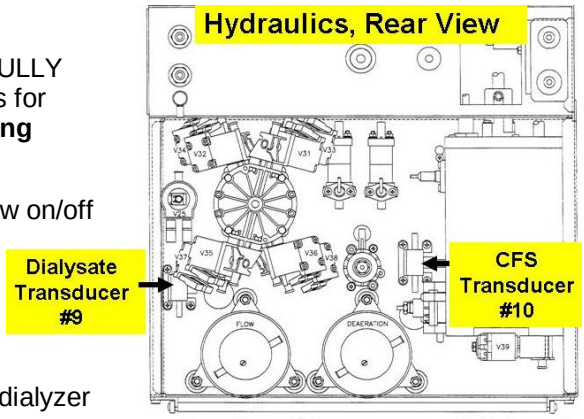
Scenario #4: ***See Figure D*. If (and ONLY if) OBSERVED drain flow = Continuous slow flow. It NEVER, EVER stops. Individual 'pulses' CAN NEVER be distinguished:**

See procedure number F- 6.2.0 (page 29).

Figure D



F- 6.1.0 CHECK DIALYSATE PRESSURE TRANSDUCER



a) Referring to the Figure (right), using a flashlight, CAREFULLY check the (blue) CFS and dialysate pressure transducers for signs of (rust colored) external leakage. **Replace a leaking transducer as this may be the problem!**

b) **IMPORTANT!** Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks).

c) Referring to the Figure (below, right), open the shunt door and ASSURE the dialyzer connectors are placed correctly.

d) Remove the red dialyzer connector and hang it over the dialyzer holder.

e) **IMPORTANT!** Close the shunt door. Ignore "Emptying" related messages.

f) Call debug screen 4. Is **PDIA** (left column) remaining between 4.0 and 6.0?

Yes See procedure number F- 6.1.2 (page 28).

No See procedure number F- 6.1.1 (page 28).

F- 6.1.1 CHECK VALVE #25

a) Return the red dialyzer line to the shunt and close the door.

b) Plug the concentrate connectors into their respective rinse ports.

c) Place the machine into Rinse Program. Does the 'bob', inside the external flow indicator, rise (at least ¼ way up) and fall?

Yes a) Plug into concentrate and return to Dialysis Program (remember to press the "CONFIRM' key).

b) Proceed to **page 184**, procedure number **TMP- 2.1.0**.

No Recheck DRAIN flow. If there is flow see number **F- 14.0.0** (page 48). If there is NO flow return to Dialysis program (remember to press the 'CONFIRM' key) then see procedure number F- 6.3.0 (page 30).

F- 6.1.2 ANALYZE DRAIN FLOW

a) **IMPORTANT!** Return the dialyzer connectors to the shunt and close the door.

b) **IMPORTANT!** Turn Dialysate flow ON (Dialysate Flow on/off LED off).

c) Per procedure number F- 6.0.0 (page 26), drain flow is:

1) **Pulse – Stop – Pulse – Stop – etc. No Dribble EVER:** See procedure number F- 6.1.3 (page 29).

2) **Pulse – Stop – Pulse – Dribble – etc:** Call the Home screen. Is **Conductivity** greater than 16.5 mS?

Yes See procedure number F- 7.0.0 (page 32).

No See procedure number F- 6.5.0 (page 31).

F- 6.1.3 VERIFY FLOW RATE (BC SWITCH)

a) Call debug screen 1. If **NPHT** is less than 600 press and hold the "1" numeric keypad until **NPHT** is greater than 600. **Ignore an "On Line PHT Failed" message if it occurs.**

b) Call the Home screen. **NOTE** the **selected** Dialysate Flow rate. ASSURE it is NOT set to "a300", "a500" or "a800". **IMPORTANT!** If Dialysate flow rate is or was changed allow three minutes for stabilization. **If Flow is manually changed remember to press the 'CONFIRM' key.**

c) **IMPORTANT!** Do NOT reset alarms!

d) Call debug screen 6 and watch **BC Switch** for one minute. Two scenarios:

1. **BC Switch = 897 constant:** See procedure number F- 8.0.0 (page 42).
2. **BC Switch is NOT 897 constant:** See Table C (page 29):

TABLE C

If NOTED selected Dialysate Flow rate is:	Is BC Switch remaining between:
300 ml/min	540 and 660 (5.40 and 6.60 seconds)?
500 ml/min	324 and 396 (3.24 and 3.96 seconds)?
800 ml/min	203 and 248 (2.03 and 2.48 seconds)?

Yes A Flow Problem is not presenting at this time. See procedure number F- 3.0.0 (page 20).

No a) Call the Home screen and check the selected flow rate. It may have defaulted to a different rate other than what was noted above (idle flow option). If (and ONLY if) flow rate has changed repeat procedure number F- 6.1.4 (page 29).

b) Is **Conductivity** greater than 16.0 mS?

Yes See procedure number F- 7.0.0 (page 32).

No See procedure number F- 6.5.0 (page 31).

F- 6.2.0 CHECK FLOW MOTOR / CHECK LOADING PRESSURE

a) If (and ONLY if) the Flow Motor is NOT rotating **counterclockwise NOTE** the **FLOW MOTOR** ONLY will be checked then proceed to **page 60**, TROUBLESHOOTING MOTORS.

b) Assuring the shunt door is closed, is loading pressure still peaking to between: 23 and 27 psi (equipped with DiaSafe® filter); 17 and 23 psi (NOT equipped with DiaSafe® filter)?

Yes Call the Home screen and note **Conductivity**. Three drain flow scenarios. Proceed accordingly:

1. **NO drain flow EVER:** See procedure number F- 6.3.0 (page 30).
2. **There is drain flow but it NEVER stops AND Conductivity is greater than 16.0 mS:** See procedure number F- 6.3.0 (page 30).
3. **There is drain flow but it NEVER stops AND Conductivity is NOT greater than 16.0 mS:** See procedure number F- 6.5.0 (page 31).

No See procedure number F- 15.0.0 (page 53).

F- 6.3.0 CHECK DRAIN VALVE #30 INPUT

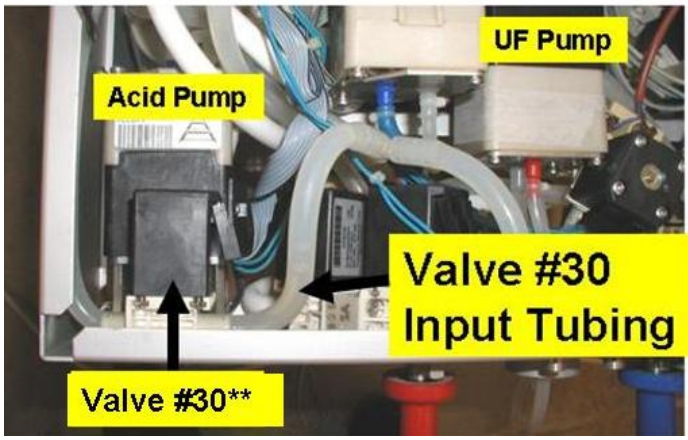
A 1000 ml graduated cylinder and a bucket of water is required:

a) From the Home screen ASSURE Dialysate flow is set to 800 ml/min (NOT "a800").

b) Remove the dialyzer quick connectors from the shunt and place them into a bucket of water on the floor.

c) **IMPORTANT!** Close the shunt door!

d) **BE CAREFUL HERE!** Referring to Figure 10 (page 30), clamp and remove valve 30's** **INPUT** tubing and direct it so that spillage into the machine does NOT occur. Continue with part e.



** If the machine is equipped with the Aliquot option valve #30 is in a different location. Refer to Figure 11 (page 30).

Figure 10 – Valve #30 Location (NO Aliquot)

e) **IMPORTANT!** Remove the clamp from valve #30 and allow 30 seconds for stabilization.

f) AFTER 30 seconds and **without turning Dialysate flow off**, measure flow for one minute. Two measurements are recommended. Greater than 750 ml/min?

Yes See procedure number F- 6.4.0 (page 31).

No a) Reattach valve #30's tubing and return the dialyzer lines to the shunt

b) See procedure number F- 7.0.0 (page 32).

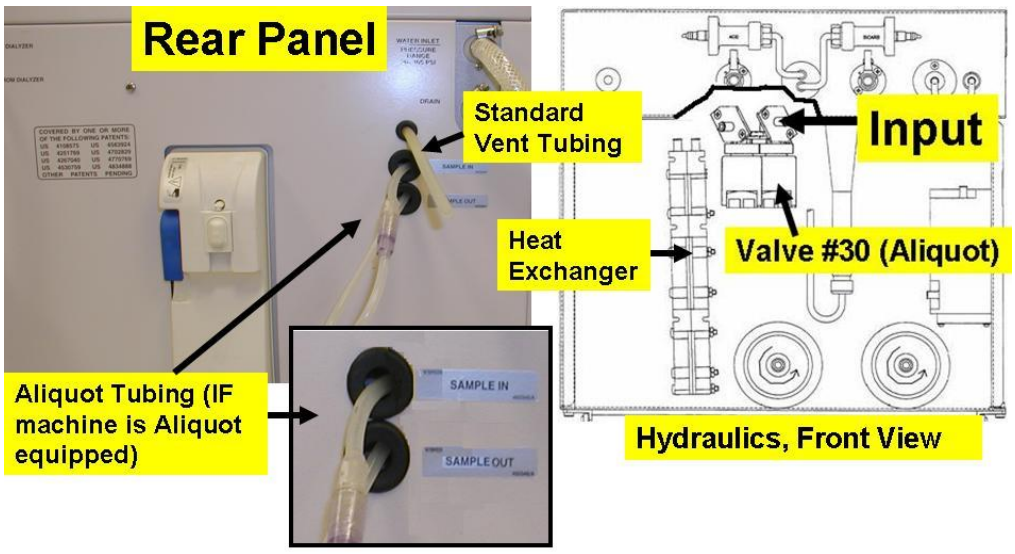
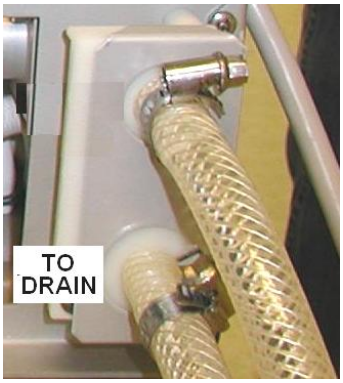


Figure 11 – Valve #30 Location (with Aliquot Option)

F- 6.4.0 CHECK FLOW FROM VALVE #30 (FROM THE DRAIN NOZZLE)



a) Reattach valve #30's tubing but leave the connectors in the bucket for now.

b) From the Home screen, ASSURE Dialysate flow is set to 800 ml/min (NOT "a800").

c) Referring to the Figure (right), remove the tubing from 'To Drain' (***BOTTOM!**) nozzle at the rear of the machine. ***CAUTION! Do NOT remove the top ('inlet water') tubing!**

d) Press and release the 'RESET' key then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. It a TMP alarm occurs attempt the RESET sequence up to twice more then continue.

e) **IMPORTANT!** ASSURE Dialysate flow is ON (Dialysate Flow on/off LED off) and allow 20 seconds for stabilization.

f) **Without turning Dialysate flow off**, measure flow from the drain nozzle for one minute. Two measurements are recommended especially if the first is low. Greater than 750 ml/min?

Yes Using a flashlight, check the drain tubing for restrictions, possibly bio-growth. If no restrictions are located the drain 'quick connector' (if present) may be bad.

No a) **CAREFULLY** (use a flashlight) check for restrictions, possibly bio-growth, inside the 'To Drain' nozzle AND through valve #30's clear OUTPUT tubing between the valve and the 'To Drain' nozzle. **If a restriction is located this is the problem!**

b) Referring to Figure 10 (page 30), touch valve #30's (black) solenoid. Is it hot (i.e. energized)?

Yes The actuator board is okay. Replace valve #30.

No **NOTE** that VALVE #30 (ONLY) will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

F- 6.5.0 CHECK TRANSMEMBRANE PRESSURE (TMP)

a) Call the Home screen, set Dialysate Flow to 500 ml/min (NOT "a500") and press the 'CONFIRM' key.

b) Referring to Figure 12 (page 31), the TMP bar graph is populated with three horizontal **bars**; yellow upper and lower alarm Limits (positioned at 520 and 0) and an 'actual' TMP **bar** which is either red (with a TMP alarm) or green (no TMP alarm). TMP is also displayed digitally at the top of the bar graph.

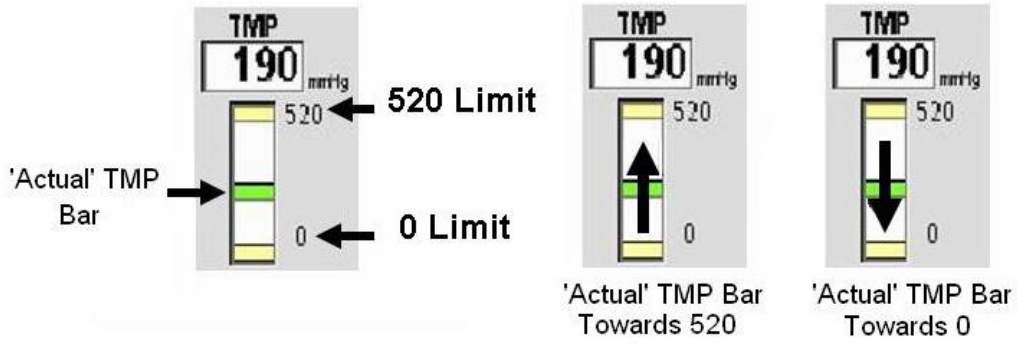


Figure 12 – TMP Bar Graph

c) Press and release the 'RESET' key and then immediately press and hold it for three seconds. If a TMP alarm reoccurs attempt RESET twice more.

d) Watch the (green or red) 'actual' TMP bar. TMP is STABLE if (and ONLY if) it REMAINS between the 0 and 520 limits AND varies less than +/- 40 mmHg in two minutes. Proceed accordingly (three scenarios):

1. **TMP is UNSTABLE if the 'actual' TMP bar rises (↑), greater than +40, toward the 520 Limit OR exceeds the 520 Limit causing a "TMP Is High" alarm:** See procedure number F- 6.6.0 (page 32).
2. **TMP is UNSTABLE if the 'actual' TMP bar falls (↓), greater than -40, toward the lower 0 Limit OR falls below the 0 Limit causing a "TMP Is LOW" alarm:** See procedure number F- 6.6.0 (page 32).
3. **TMP is STABLE:** See procedure number F- 6.7.0 (page 32).

F- 6.6.0 TROUBLESHOOT FLOW ERROR (UNSTABLE TMP)

NOTE this procedure and page number. It may be necessary to perform all procedures below:

a) **NOTE** nine leak tests will be performed: **1)** IOS; **2)** Balancing Chamber Valves #31 through #38. See SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

b) If a leak is not located, perform SECTION 19 - TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM (page 238).

c) If a diaphragm leak is not located, return to Dialysis program. If the Flow Error reoccurs see procedure number F- 1.0.2 (page 14).

F- 6.7.0 TROUBLESHOOT FLOW ERROR (STABLE TMP)

NOTE this procedure and page number. It may be necessary to perform all procedures below:

a) Possible torn balancing chamber diaphragm. Proceed to SECTION 19 - TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM (page 238).

b) **NOTE** nine leak tests will be performed: **1)** IOS; **2)** Balancing Chamber Valves #31 through #38. See SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

c) Return to Dialysis program (remember to press the 'CONFIRM' key). Call screen 0. If **Flow Error** = 1 (constant or intermittent) return to procedure number F- 1.0.2 (page 14).

F- 7.0.0 DETERMINE DIASAFE® OPTIONS

a) Assure the dialyzer quick connectors are in the shunt with the door closed.

b) Re-check loading pressure. If (and ONLY if) it is NOT 'okay' return to procedure number F- 2.0.4 (page 18).

c) Call debug screen 0. Referring Figure 13 (page 33), how to proceed depends on DiaSafe® Filter options. Two scenarios:

1. **NOT equipped with DiaSafe® filter:** In rare cases the DiaSafe® filter may have been removed but Test Valve #91 remains installed. The knob MUST be pointing to 'DIALYZE' (see Figure, right) otherwise flow is blocked at the valve. Proceed to F- 7.0.2 (page 33).
2. **Equipped with a DiaSafe® Filter:** CAREFULLY check the tubing to and from the DiaSafe® filter for kinks. If equipped with Test Valve #91, assure the knob is pointing to 'DIALYZE' (see Figure, right) otherwise flow is blocked at the valve. Proceed to F- 7.0.2 (page 33).

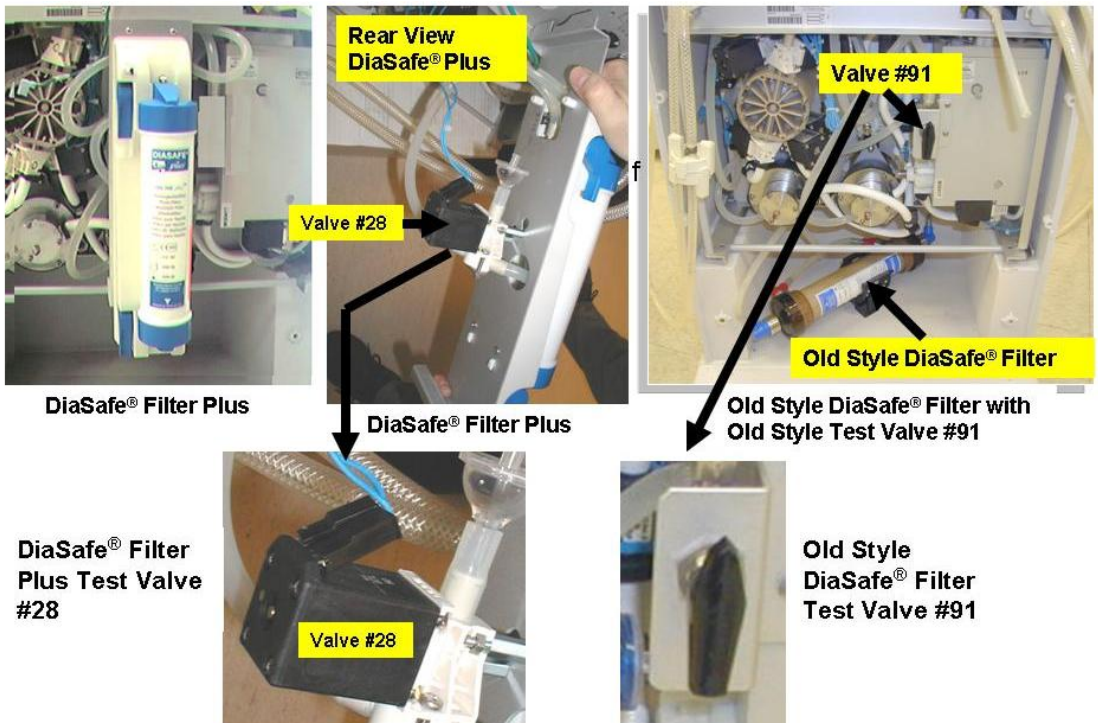


Figure 13 – DiaSafe® Filter / Test Valve Configurations

F- 7.0.2 CHECKING SECONDARY 'FRESH' PATHS

These procedures check various flow paths and if done correctly can save hours of work. Distribution board connectors are manually switched to open various flow paths and flow is measured into a 1000 ml graduated cylinder for 30 seconds. Be **VERY CAREFUL** to **NOTE** connector and distribution board labeling! ASSURE all connectors are aligned properly after switching them! **CAUTION!** Assure the card cage is CLOSED

a) **VERY IMPORTANT!** Assure Dialysate Flow is ON (Dialysate Flow on/off LED off)!

b) Plug the red concentrate connector into its rinse port to call the "Select Program" screen. **Do NOT start a Cleaning / Disinfection program!**

c) With the "Select Program" screen up, perform **BOTH** PARTS 1 and 2 below:

PART 1: a) **CAREFULLY** plug valve #35 into valve #30's distribution board position labeled ("V30" or "P30"). **Valve #30 remains unplugged!**

b) Remove the red dialyzer connector from the shunt door and measure flow from it for 30 seconds. If no flow, **carefully double check connector placement!** If there is flow, two measurements are recommended!

c) RECORD PART 1 results then perform PART 2 EVEN IF there is no flow.

PART 2: a) **CAREFULLY** return valve #35 to its distribution board position.

b) **CAREFULLY** plug valve #37 into valve #30's distribution board position and measure flow, from the red dialyzer connector, for 30 seconds.

c) **Do NOT unplug valve #37 until instructed otherwise!**

d) Four possible scenarios based on PART 1 AND PART 2 results. Respond according to Table 2 (page 34):

Table 2 – Parts 1 AND 2

	PART 1, 400 ml or greater?	**PART 2**, 400 ml or greater?	**Your Response**
1	No	No	See procedure number F- 7.0.5 (page 35)
2	No	Yes	See procedure number F- 7.0.3 (page 34)
3	Yes	No	See procedure number F- 7.0.4 (page 35)
4	Yes	Yes	See procedure number F- 7.3.1 (page 38)

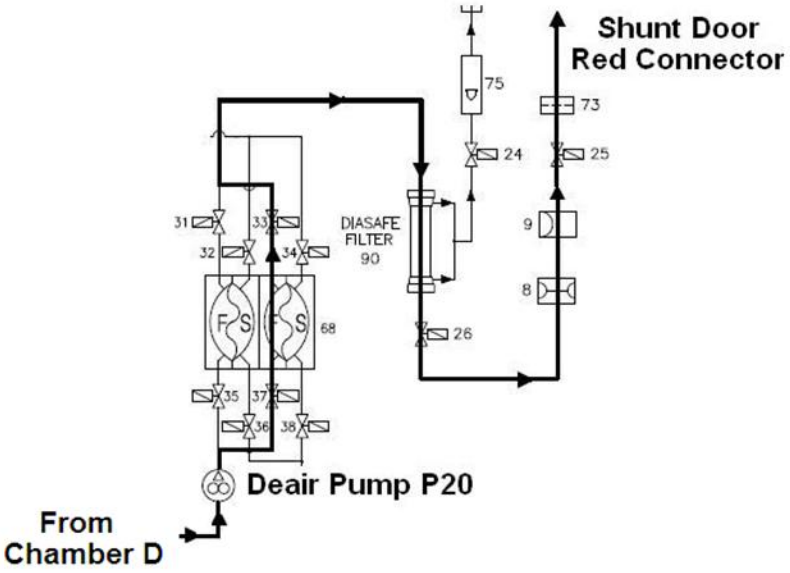


Figure 14 – Part 2

F- 7.0.3 TROUBLESHOOTING VALVES #31 AND #35

a) **CAREFULLY** return valves #30 and #37 to their distribution board positions.

b) Place the machine into Rinse program. After six minutes, referring to Figure 15 (page 35), touch the (black) solenoids of BOTH valves #31 and #35. **NOTE! Valve #31 is normally warmer than valve #35**. Are both warm (energized)?

Yes Valve #31 and/or valve #35 not opening! **Automated Valve Leak Tests will NOT help!**

No **NOTE** that **BOTH** VALVES #31 **AND** #35 will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

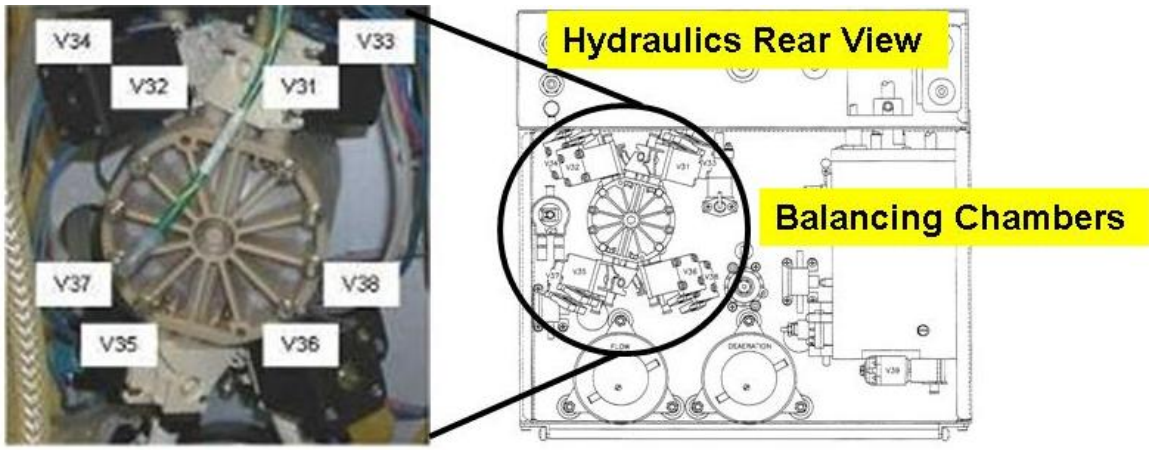


Figure 15 – Balancing Chamber Valves

F- 7.0.4 TROUBLESHOOTING VALVES #33 AND #37

a) **CAREFULLY** return valves #30 and #37 to their distribution board positions.

b) Place the machine into Rinse program. After six minutes, and referring to Figure 15 (page 35), touch the (black) solenoids of BOTH valves #33 and #37. **NOTE! Valve #33 is normally warmer that valve #37**. Are both warm (energized)?

Yes Valve #33 and/or valve #37 not opening! **Automated Valve Leak Tests will NOT help!**

No **NOTE** that **BOTH** VALVES #33 **AND** #37 will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

F- 7.0.5 CHECK VALVE #26 INPUT FLOW

a) The "Select Program" screen MUST still be up! Valve #37 MUST remain plugged into valve 30's distribution board position.

b) **BE CAREFUL HERE!** Referring to Figure 16 (page 35), valve #26 will be in one of two locations. Clamp and remove its **INPUT TUBING!** Do NOT allow spillage into the machine!

c) Remove the clamp and measure flow from the tubing for 30 seconds. 400 ml or greater?

Yes See procedure number F- 7.0.6 (page 36),

No See procedure number F- 7.0.9 (page 37).

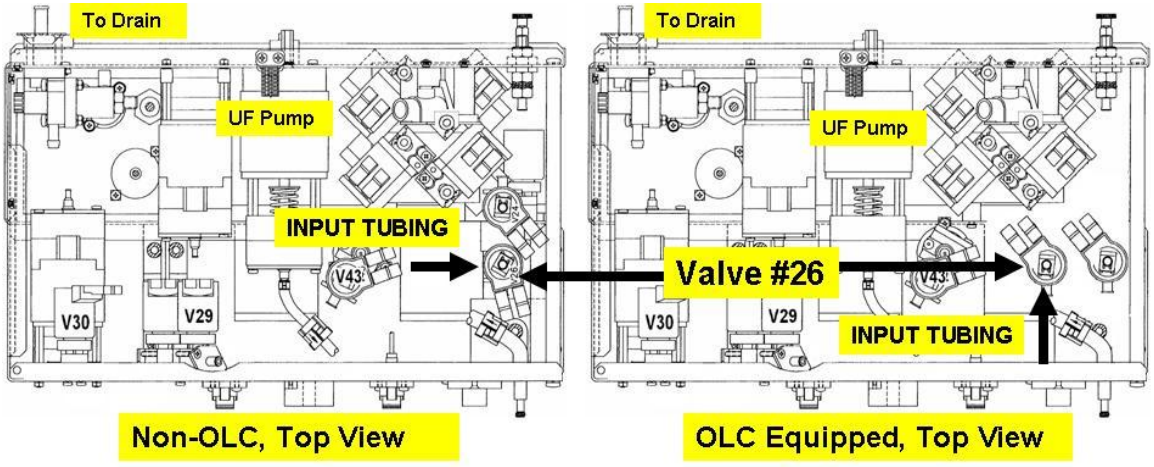


Figure 16 – Valve #26 Location

F- 7.0.6 CHECK FLOW PUMP #21 INPUT FLOW

a) Clamp valves #26's tubing and reattach it.

b) The "Select Program" screen MUST still be up!

c) Valve #37 MUST remain plugged into valve 30's distribution board position ("V30")!

d) Referring to Figure 17 (page 36), remove the clear tubing from the INPUT of the Flow Pump and direct it into the cylinder.

e) Remove the clamp from valve #26 and measure flow from the tubing for 30 seconds. 400 ml or greater?

Yes See procedure number F- 7.0.8 (page 36).

No See procedure number F- 7.0.7 (page 36).

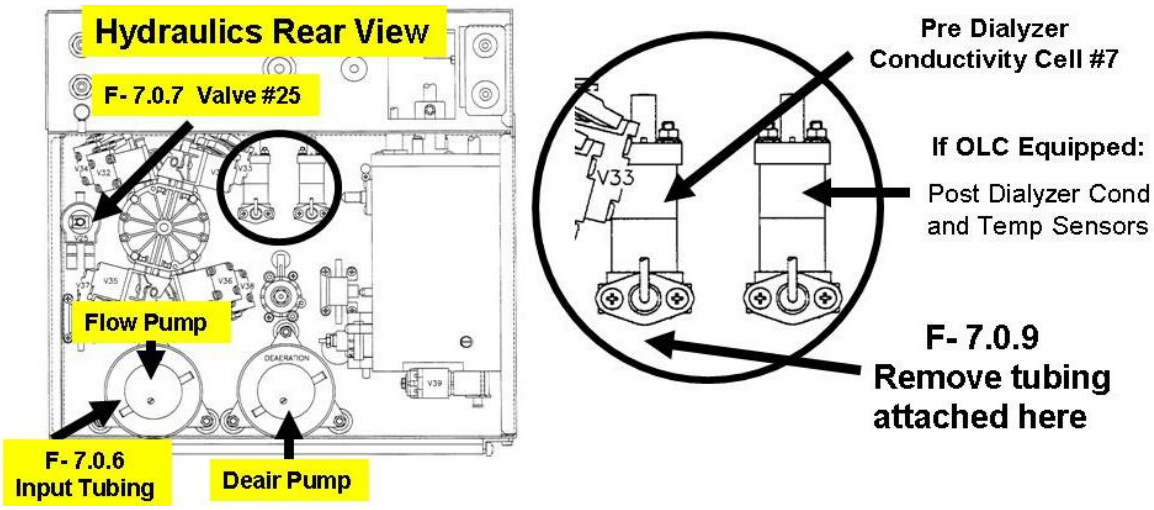


Figure 17 – Hydraulics (Rear View)

F- 7.0.7 CHECK VALVE #26

a) Return valves #30 and #37 to the distribution board.

b) Referring to Figure 17 (page 36), touch valve #26's (black) solenoid. Is it warm (i.e. energized)?

Yes The actuator board okay. Replace valve #26.

No **NOTE** that VALVES #26 (ONLY) will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

F- 7.0.8 CHECK VALVE #25

NOTE! It is possible that after repairing a problem related to valve #25 that a Flow Error will still be present. There may be two malfunctions:

a) Return valves #30 and #37 to the distribution board.

b) Referring to Figure 24 (page 50), check external dialysate line filter #73 (if present) for restrictions. **If a restriction is found this may be the problem!**

c) Referring to Figure 17 (page 36), touch valve #25's (black) solenoid. Is it warm (i.e. energized)?

Yes The actuator board is okay. Replace valve #25.

No **NOTE** that VALVES #25 (ONLY) will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

F- 7.0.9 CHECK FLOW FROM THE BALANCING CHAMBERS

a) Reattach the tubing to valve #26.

b) The "Select Program" screen MUST still be up!

c) Valve #37 MUST remain plugged into valve 30's distribution board position ("V30")!

d) Referring to Figure 17 (page 36), clamp and remove the tubing at conductivity cell #7.

e) Remove the clamp and measure flow from the tubing for 30 seconds. Greater than 400 ml?

Yes
a) Clamp and reattach the tubing to the conductivity cell.
b) See procedure number F- 7.1.0 (page 37).

No
a) CAREFULLY return valve #37 to its distribution board position.
b) CAREFULLY return valve #35 to valve #30's distribution board position (labeled "V30" or "P30").
c) Measure flow from the tubing for 30 seconds. Greater than 400 ml?

Yes **CAREFULLY** return valves #30 and #35 to their distribution board positions then return to procedure number F- 7.0.4 (page 35) and proceed from part b.

No Assuming that above procedures were performed correctly, it appears that valves #31 and/or #33 and/or #35 and/or #37 are restricted or the actuator board or actuator cable is bad.

F- 7.1.0 DETERMINE DIASAFE® FILTER OPTIONS

a) **IMPORTANT!** Remove the clamp at the conductivity cell's tubing.

b) How to proceed depends on if the machine is equipped with a DiaSafe® filter:

- **NOT equipped with DiaSafe®:** Check for tubing restrictions between conductivity cell #7 and valve #26
- **Equipped with DiaSafe® filter Plus:** Check for tubing restrictions between conductivity cell #7 and the DiaSafe® filter. If no restrictions are located, replace the DiaSafe® filter
- **Equipped with Old Style DiaSafe® filter:** See procedure number F- 7.2.0 (page 37)

F- 7.2.0 CHECK FLOW FROM TEST VALVE #91 (Old Style DiaSafe® Filter Only)

a) Check for restrictions in the tubing between conductivity cell #7 and the DiaSafe® filter.

b) If no restrictions are located, referring to Figure 18 (page 38), trace the tubing from the horizontal (i.e. 'Common') Port of Test Valve #91 to the DiaSafe® filter's quick connector. Continue to F- 7.2.0, part c.

c) Remove the quick connector and measure flow from it for 30 seconds. Greater than 400 ml?

Yes Replace the DiaSafe® Filter.

No Test valve #91 or its tubing is restricted.

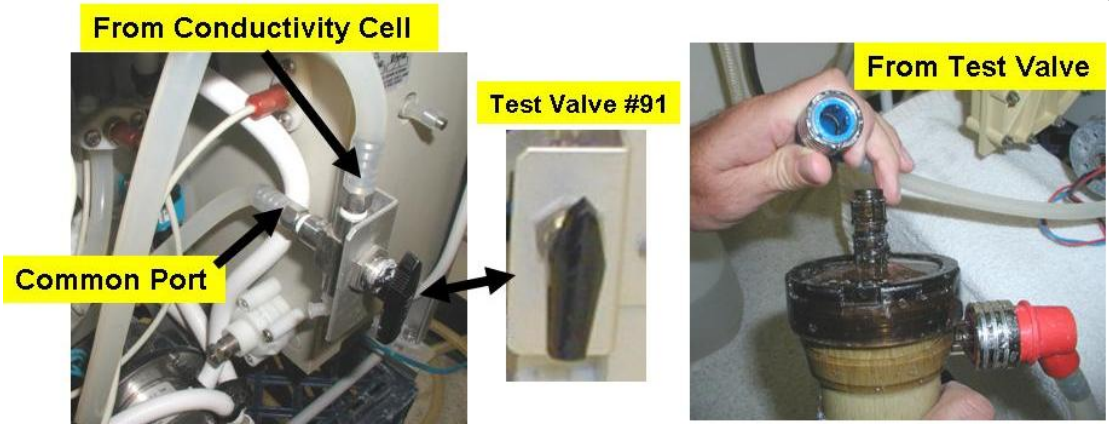


Figure 18 – Old Style DiaSafe® Filter

F- 7.3.1 CHECK FLOW PUMP

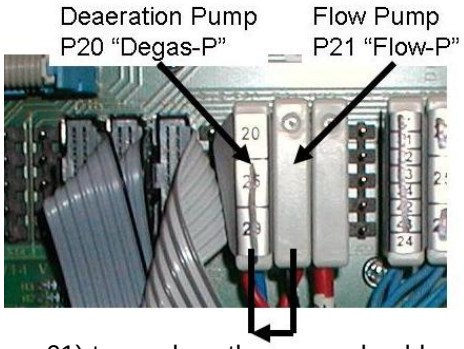
A bucket FILLED with at least three liters of water is required for this procedure:

a) CAREFULLY return valve #30 and #37 to their distribution board positions.

b) The "Select Program" screen MUST still be up!

c) Drop the red dialyzer quick connector into a bucket FILLED with water on the floor. **Assure the connector REMAINS submersed!**

d) Referring to the Figure (right), CAREFULLY plug the flow pump (from P21, "FLOW-P") into the deaeration pump's distribution board position (P20, "DEGAS-P").



e) Referring to Figure 17 (page 36), **if the connectors are placed properly**, the FLOW PUMP is running strong AND the DEAERTION PUMP is NOT running!

f) Are large air bubbles continually flowing from the submersed red dialyzer connector?

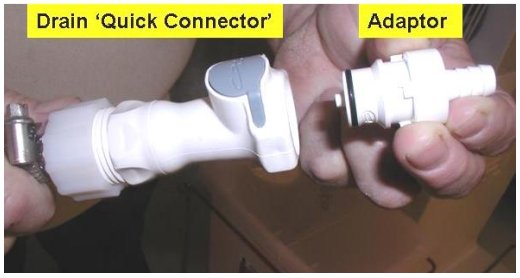
Yes The FLOW PUMP head is upside down! See Figure 29 (page 61) to see how the pump should be installed!

No See procedure number F- 7.3.2 (page 38).

F- 7.3.2 CHECK SECONDARY 'SPENT' PATHS

These procedures check flow to drain:

a) Referring to the Figure (right), at the end of the machine's DRAIN tubing if a 'Quick Connector' is present, an **adaptor** IS required to allow drain flow.



b) Perform **BOTH** PARTS 3 and 4 below:

PART 3:

a) **CAREFULLY** plug valve #36 into valve #33's distribution board position (labeled "V33" or "P33").

b) Measure flow to drain for 30 seconds. If no flow, **carefully double check connector placement!** If there is flow, two measurements are recommended!

b) **RECORD** PART 3 results then perform PART 4 EVEN IF there no flow.

PART 4: a) **CAREFULLY** return valves #36 AND #33 to their distribution board positions.

b) **CAUTION!** Refill the bucket if necessary! **It MUST NEVER run empty!**

c) **CAREFULLY** plug valve #38 into valve #31's distribution board position (labeled "V31" or "P31") and measure flow to drain for 30 seconds.

e) UNPLUG valve #38 but do not return it to the distribution board until instructed.

f) Four possible scenarios based on PART 3 **AND** PART 4 results. Respond according to Table 3 (page 39):

Table 3 – Parts 3 AND 4

PART 3, 400 ml or greater?	**PART 4**, 400 ml or greater?	**Your Response**
No	No	See procedure number F- 7.4.0 (page 39)
No	Yes	See procedure number F- 7.6.0 (page 41)
Yes	No	See procedure number F- 7.7.0 (page 42)
Yes	Yes	See procedure number F- 7.8.0 (page 42)

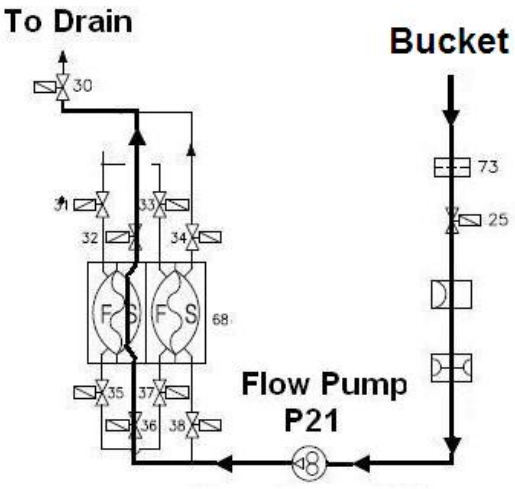
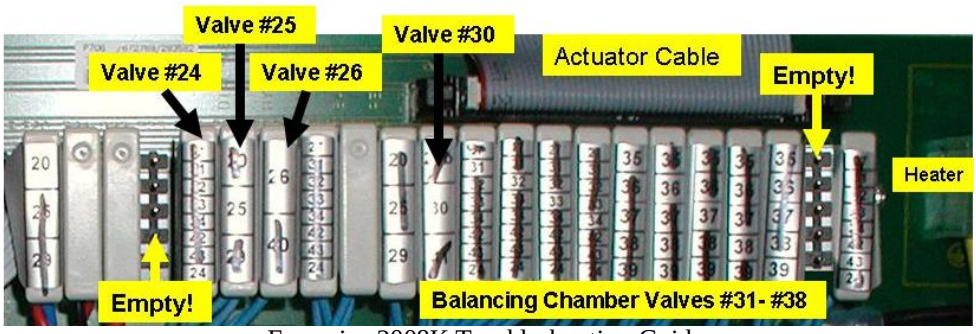


Figure 19 – Part 3

F- 7.4.0 CHECK VALVE #30 INPUT FLOW

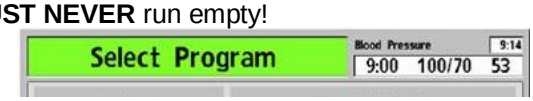
a) **No flow is unlikely!** Referring to the Figure (below) ASSURE that all valves**, except valves #38 and #31** (left unplugged above) are plugged into the distribution board correctly! **Check especially valve #25! It BELONGS at position V25, labeled "DIAL-V25"!** If (and ONLY if) a valve is NOT plugged in correctly CAREFULLY return ALL valves to their distribution board positions and repeat procedure number F- 7.3.2 (page 38). If all valves ARE plugged in correctly (except for valves #38 and #31) continue to part b.



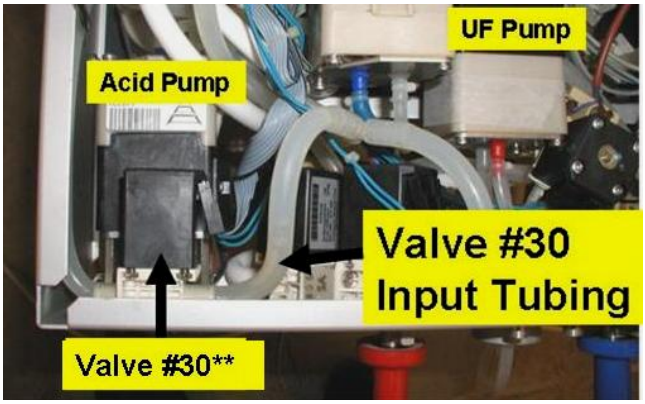
b) Double check the flow pump is running hard and counterclockwise!

c) **IMPORTANT!** Refill the bucket if necessary! It **MUST NEVER** run empty!

d) The "Select Program" screen MUST still be up!



e) Referring to the Figure (right)**, remove valve #30's INPUT tubing and hold it so that spillage into the machine will not occur.



** If the machine is equipped with the Aliquot option valve #30 is in a different location. Refer to Figure 11 (page 30).

f) **CAREFULLY** return valve #38 to valve #31's distribution board position.

g) Measure flow from the tubing for 30 seconds. 400 ml or greater?

Yes Reattach valve #30's tubing then see procedure number F- 7.4.1 (page 40).

No Reattach valve #30's tubing then see procedure number F- 7.5.0 (page 40).

F- 7.4.1 TROUBLESHOOT VALVE #30

a) **CAREFULLY** return valve #31 AND #38 to their distribution board positions.

b) If a drain line 'Quick Connector' is used consider repeating procedure number F- 7.3.2 (page 38), with the 'Quick Connector' removed OR directly from the rear drain nozzle just in case the 'Quick Connector' or drain tubing is fully restricted.

c) **CAREFULLY** return the flow and deaeration pump to their distribution board positions.

d) Touch **valve #30's** (black) solenoid. Is it hot (i.e. energized)?

Yes Assuming all procedures have been performed correctly valve #30 may be bad.

No **NOTE** that VALVE #30 (ONLY) will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

F- 7.5.0 CHECK FLOW PUMP #21

a) **CAREFULLY** return valve #31 AND #38 to their distribution board positions.

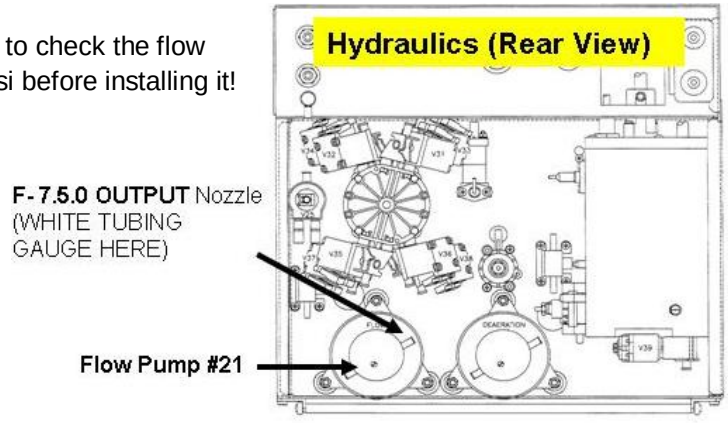
b) **CAREFULLY** return the flow and deaeration pump to their respective distribution board positions ("P20 and "P21").

c) This procedure uses a pressure (psi) gauge to check the flow pump. **IMPORTANT!** Assure it reads 0 psi before installing it!

d) Referring to the Figure (right), tee the gauge between the flow pump's OUTPUT NOZZLE and the WHITE tubing.

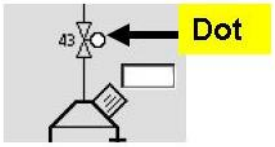
e) Place the machine into Rinse Program. Assure no leaks at the gauge.

f) Assure the flow AND deaeration pumps are running (i.e. they are plugged in correctly).



g) Pressure should fluctuate between a minimum and a maximum. The maximum depends on if the machine is DiaSafe® filter equipped.

h) **IMPORTANT!** Call debug screen 0. Allow valve #43's dot to turn blue (see Figure right). When it turns white again begin watching the gauge for one minute.



i) Does pressure consistently reach its maximum pressure per **Table O** (page 41)?

Yes See procedure number F- 7.5.1 (page 41).

No See procedure number F- 9.0.1 (page 43).

Table O – Flow Pump Pressure

DiaSafe Filter?	Maximum Pressure
Yes	35 – 36 psi
No	29 – 30 psi

F- 7.5.1 CHECK FLOW ERROR

a) Attach to fresh concentrate and return to Dialysis program (remember to press the 'CONFIRM' key).

b) Call debug screen 0. Watch **Flow Error** for four minutes or until if **Flow Error** = 1 (intermittent or constant). Proceed accordingly (two scenarios):

1. **Flow Error = 1: Read this procedure before performing it!** Return to procedure number F- 1.0.3 (page 15) and BE CAREFUL. If you return here possibilities because of NO flow at all, possibilities: **1)** Bad actuator board; **2)** Stuck closed valves #32 and/or #34 and/or #36 and/or #38.
2. **Flow Error = 0 (constant):** The above procedures may have eliminated a restriction! Watch closely for five additional minutes.

F- 7.6.0 TROUBLESHOOT VALVES #32 AND #36

a) CAREFULLY return valve #31 AND #38 to their distribution board positions.

b) CAREFULLY return the flow and deaeration pump to their distribution board positions.

c) Place the machine into Rinse program. After six minutes, and referring to Figure 20 (page 41), touch the (black) solenoids of valves #32 and #36. **NOTE! Valve #32 is normally warmer than valve #36**. Are both warm (energized)?

Yes Valve #32 and/or valve #36 not opening! **Automated Valve Leak Tests will NOT help!**

No **NOTE** that **BOTH** VALVES #32 **AND** #36 will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

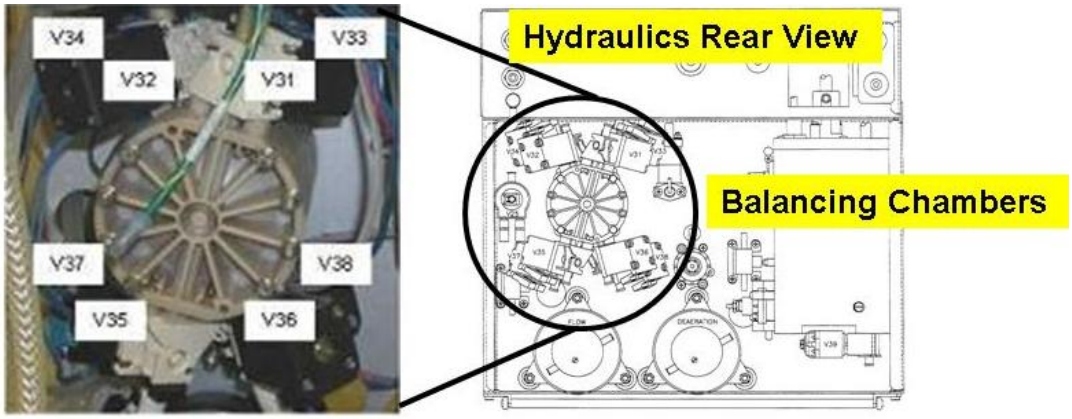


Figure 20 – Balancing Chamber Valves

F- 7.7.0 TROUBLESHOOT VALVES #34 AND #38

a) CAREFULLY return valve #31 AND #38 to their distribution board positions.

b) CAREFULLY return the flow and deaeration pump to their distribution board positions.

c) Place the machine into Rinse program. After six minutes, and referring to referring to Figure 20 (page 41), touch the (black) solenoids of valves #34 and #38. **NOTE! Valve #34 is normally warmer than valve #38**. Are both warm (energized)?

Yes Valve #34 and/or valve #38 not opening! **Automated Valve Leak Tests will NOT help!**

No **NOTE** that **BOTH** VALVES #34 **AND** #38 will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

F- 7.8.0 CHECK FLOW ERROR

All secondary flow paths are open!

a) **CAREFULLY** return valve #31 AND #38 to their distribution board positions.

b) **CAREFULLY** return the flow and deaeration pump to their distribution board positions.

c) Return to Dialysis program (remember to press the 'CONFIRM' key).

d) Call debug screen 0 and watch **Flow Error** for four minutes or until if **Flow Error** = 1 (intermittent or constant). Proceed accordingly (two scenarios):

1) **Flow Error = 1:** a) ASSURE that the deaeration and Flow pump are running (i.e. plugged into the distribution board correctly)!
   b) ASSURE that all valves are plugged into the distribution board correctly!
   c) Return to procedure number F- 1.0.3 (page 15).

2) **Flow Error = 0 (constant):** The above procedures may have eliminated a restriction in one of the flow paths. A Flow Error is not presenting so do NOT continue at this time!

F- 8.0.0 CHECK ACFS (Debug screen 10)

a) Assure Dialysate Flow is ON (Dialysate Flow on/off LED off)!

b) **IMPORTANT!** CAREFULLY watch loading pressure for two minutes. It MUST be cycling between its maximum and to NO LOWER than its minimum per Table 1 (page 18). If (and ONLY if) there is a problem with loading pressure return to procedure number F- 2.0.4 (page 18).

c) Call debug screen 10. This screen shows voltages from various sensors that include 'real time' and 'recorded' (HI and LO) values. Recording begins one minute after the machine is turned on.

d) Watch **ACFS** (ignore HI and LO for now). Proceed accordingly (three scenarios):

1. **ACFS = Between 0 and 3.0:** See procedure number F- 11.0.0 (page 46).
2. **ACFS = Between 3.1 and 8.0:** See procedure number F- 9.0.0 (page 42).
3. **ACFS = Between 8.1 and 13.0:** See procedure number F- 10.0.0 (page 46).

F- 9.0.0 CHECK FLOW PUMP #21 PRESSURE

This procedure checks that the flow pump can create adequate pressure. A psi pressure gauge is installed at the flow pump. **IMPORTANT!** Assure it reads 0 psi before installing it!

a) Referring to Figure 7 (page 15) if (and ONLY if) the Flow Motor shaft is NOT rotating **counterclockwise NOTE** the **FLOW MOTOR** ONLY will be checked and proceed to page 60, TROUBLESHOOTING MOTORS.

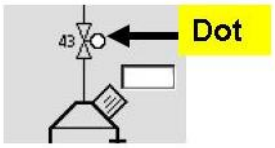
b) Plug the concentrate connectors into their respective rinse ports to call the "Select Concentrate" screen.

c) Referring to Figure 21 (page 43) tee a pressure gauge between the flow pump's OUTPUT nozzle and the WHITE tubing.

d) Place the machine into Rinse program. Assure no leaks at the gauge!

e) Pressure should fluctuate between a minimum and a maximum. The maximum depends on if the machine is DiaSafe® filter equipped.

f) Call debug screen 0. Allow valve #43's dot to turn blue (see Figure right). When the dot **turns white again** watch the gauge for one minute.



g) Does pressure consistently reach its maximum pressure per Table L (page 43)?

Yes See procedure number F- 9.0.4 (page 44).

No See procedure number F- 9.0.1 (page 43).

Table L – Flow Pump Pressure

DiaSafe Filter?	Maximum Pressure
Yes	35 – 36 psi
No	29 – 36 psi

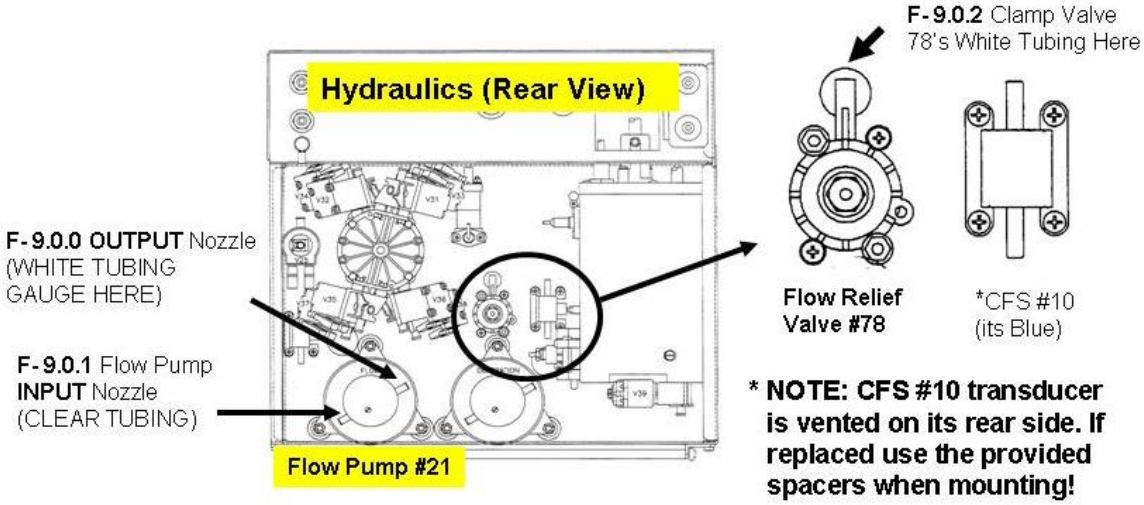


Figure 21 - Hydraulics (Rear View)

F- 9.0.1 CHECK FLOW PUMP RELIEF VALVES #78

This is not a routine calibration. Follow the procedure below to avoid error!

a) Enter Service Mode → Calibrate Hydraulics → Flow Pressure.

b) Press the 'CONFIRM' key to start the flow pump. **Assure its motor shaft is running counterclockwise!**

c) **Without** adjusting valve #78, is pressure reaching Table L's (page 43) maximum?

Yes Two possibilities: 1) Bad flow pump head (#21); 2) Bad flow pump motor (possibly bad brushes).

No See procedure number F- 9.0.2 (page 44).

F- 9.0.2 CHECK FLOW RELIEF VALVE #78

Referring to Figure 21 (page 43) and using pliers (i.e. **do NOT use a plastic clamp**) quickly clamp and unclamp the white tubing at the top of Flow Relief Valve #78 several times. Does pressure reach or exceed Table L's (page 43) maximum pressure?

Yes Replace Flow Relief Valve #78 with a known good then see F- 9.0.3 (page 44).

No. Two possibilities: 1) Bad flow pump #21; 2) Bad flow pump motor (possibly bad brushes);

F- 9.0.3 CHECK FLOW MOTOR

a) Enter Service Mode → Calibrate Hydraulics → Flow Pressure.

b) Press the 'CONFIRM' key to start the flow pump. **Assure its running counterclockwise!**

c) Referring to Figure 21 (page 43), adjust Flow Relief Valve #78 (clockwise increases pressure). Are you able to reach the maximum pressure indicated in Table L (page 43)?

Yes a) NOTE: If the adjustment screw had to be turned fully clockwise (i.e. threads not visible) two possibilities: **1)** Bad flow pump head (#21); **2)** Bad flow pump motor (possibly bad brushes). **After repair calibrate Flow Pressure!**

b) Return to Dialysis program (remember to press the "CONFIRM' key). If a Flow Error reoccurs see part c.

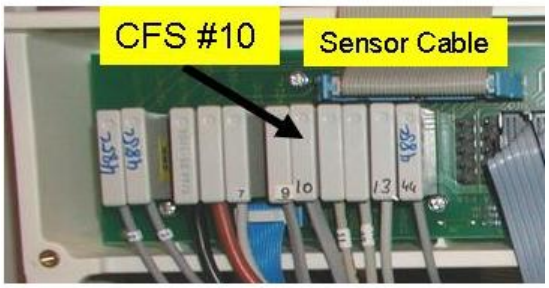
c) **Read this step completely!** Return to procedure number F- 1.0.3 (page 15) however if you return here, two possibilities: **1)** Bad flow pump head (#21); **2)** Bad flow pump motor (possibly bad brushes).

No Two possibilities: **1)** Bad flow pump head (#21); **2)** Bad flow pump motor (possibly bad brushes).

F- 9.0.4 CHECK CFS CIRCUIT

a) Attach to concentrate and return to Dialysis program (remember to press the 'CONFIRM' key).

b) Referring to the Figure (right), insert one of the resistor plugs, from the four-resistor Temperature set, into CFS #10's distribution board position x10, "CFS". This simulates a good CFS (#10) transducer.



c) From debug screen 10, does **ACFS** go to 0?

Yes See procedure number F- 9.0.5 (page 45).

No a) ASSURE the resistor plug was placed correctly before continuing! If not, repeat procedure number F- 9.0.4 (page 44) from part b.

b) Leaving the resistor plug installed for now**,** four possibilities: 1) Bad actuator board [a]: 2) Bad sensor board [b]**;** 3) Bad sensor cable [c]; 4) Bad distribution board.

[a] Swap in a known good actuator board and place the machine into Dialysis program. Call debug screen 10. If **ACFS** = 0 the previous actuator board is bad

[b] Swap in a known good sensor board (see Figure 4A, page 8). Enter Service Mode → Options → Hardware Options. Set T and C (Test and Calibration) to "Yes". Press the 'CONFIRM' key (the "x" turns blue). Place the machine into Dialysis program. Call debug screen 10. If **ACFS** = 0 the previous sensor board is bad

[c] The cable can be checked. **NOTE** that three (3) **CFS TRANSDUCER** connections will be checked and proceed to page 228, SECTION 17 - CHECKING THE SENSOR BOARD CABLE.

F- 9.0.5 ANALYZE TMP

a) Return CFS #10 to distribution board position x10, "CFS". If returned properly **ACFS** = between 3.0 and 8.1 volts.

b) Call the Home screen. Referring to Figure 22 (page 45), the TMP bar graph is populated with three horizontal **bars**; yellow upper and lower alarm Limits (positioned at 520 and 0) and an 'actual' TMP **bar** which is either red (with a TMP alarm) or green (no TMP alarm).

c) Press and release the 'RESET' key and then press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. If a TMP alarm occurs repeat the RESET sequence up to twice more then continue.

d) Watch the (green or red) 'actual' TMP bar. TMP is STABLE if (and ONLY if) it REMAINS between the 0 and 520 Limits AND varies less than +/- 40 mmHg in two minutes. Proceed accordingly (three scenarios):

1) **TMP is UNSTABLE if the 'actual' TMP bar rises (↑), greater than +40, towards the 520 Limit OR exceeds the 520 limit causing a "TMP Is High" alarm:** See procedure number F- 9.0.6 (page 45).

2) **TMP is UNSTABLE if the 'actual' TMP bar falls (↓), greater than -40, towards the 0 Limit OR falls below the 0 limit causing a "TMP Is LOW" alarm:** See procedure number F- 9.0.6 (page 45).

3) **TMP is STABLE:** See procedure number F- 9.0.7 (page 45).

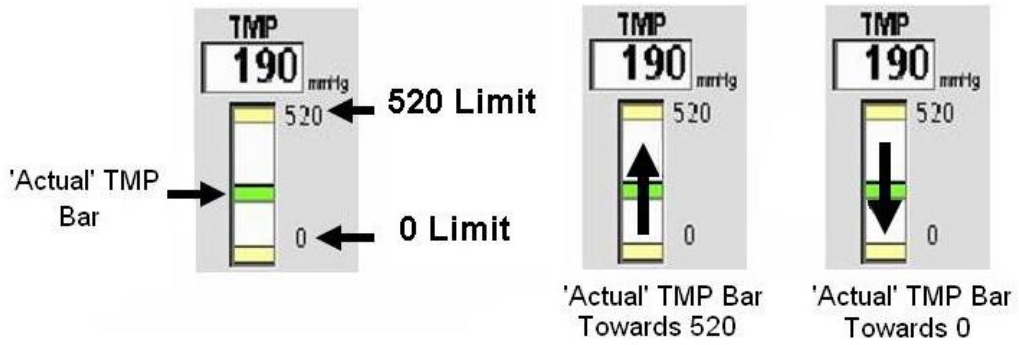


Figure 22 – TMP Bar Graph

F- 9.0.6 UNSTABLE TMP

NOTE this procedure and page number in case you need to return here:

a) **NOTE** nine leak tests will be performed: **1)** IOS; **2)** Balancing Chamber Valves #31 through #38. See SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

b) If a leak is not located, see procedure number F- 9.0.7 (page 45).

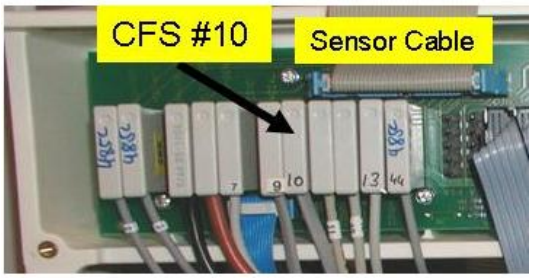
F- 9.0.7 STABLE TMP

NOTE this procedure and page number in case you need to return here:

a) Perform SECTION 19 - TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM (page 238).

b) If a diaphragm leak is not located, place the machine into Dialysis program. If **BC Switch** (screen 6) = 897 (constant) AND **ACFS** (screen 10) remains between 3 and 8 two possibilities: 1) Bad CFS transducer #10 (see Figure 21, page 43): 2 Bad sensor board.

F- 10.0.0 CFS #10 ACTING 'OPEN'



a) Referring to the Figure (right) assure the CFS #10 pressure transducer is plugged into position x10, "CFS". If not this is the problem!

b) Insert one of the resistor plugs, from the four-resistor Temperature set, into the CFS #10's distribution board position x10, "CFS". This simulates a good CFS transducer.

c) From debug screen 10, does **ACFS** go to 0 volts?

Yes The electronics are working properly. See procedure number F- 10.0.1 (page 46).

No a) **ASSURE** the resistor plug is placed properly before continuing! If not, return to procedure number F- 10.0.0 (page 46).

b) Leaving the resistor plug installed for now**,** four possibilities: 1) Bad actuator board [a]: 2) Bad sensor board [b]**;** 3) Bad sensor cable [c]; 4) Bad distribution board.

[a] Swap in a known good actuator board and place the machine into Dialysis program. Call debug screen 10. If **ACFS** = 0 the previous actuator board is bad

[b] Swap in a known good sensor board (see Figure 4A, page 8). Enter Service Mode →. Options → Hardware Options. Set T and C (Test and Calibration) to "Yes". Press the 'CONFIRM' key (the "x" turns blue). Place the machine into Dialysis program. Call debug screen 10. If **ACFS** = 0 the previous sensor board is bad

[c] The cable can be checked for continuity. **NOTE** three (3) **CFS TRANSDUCER** connections will be checked and proceed to page 228, SECTION 17 - CHECKING THE SENSOR BOARD CABLE.

F- 10.0.1 CHECK CFS TRANSDUCER

a) CAREFULLY return the CFS transducer to distribution board position x10, "CFS".

b) Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks). From debug screen 10, is **ACFS** between 3.6 and 6.5?

Yes See procedure number F- 10.0.2 (page 46).

No The CFS transducer #10 is bad (see Figure 21, page 43).

F- 10.0.2 VERIFY CFS

a) Turn Dialysate Flow On (Dialysate Flow on/off LED off) and **IMPORTANT** allow 30 seconds for transitions to occur before continuing.

b) Call debug screen 0 and CAREFULLY watch **Flow Error** for two minutes or until if **Flow Error** = 1. Proceed accordingly:

- **Flow Error = 1 (constant or intermittent):** CFS transducer #10 is bad (see Figure 21, page 43).
- **Flow Error = 0 (constant):** Problem solved! Do NOT continue to troubleshoot Flow Errors!

F- 11.0.0 CFS #10 ACTING 'SHORTED'

a) **IMPORTANT!** Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks).

b) Remove the red dialyzer connector and hang it over the dialyzer holder.

c) **IMPORTANT!** Close the shunt door. Ignore "Emptying" related messages.

d) Call debug screen 4. Is **PDIA** (left column) remaining between 4.0 and 6.0?

Yes See procedure number F- 11.0.1 (page 47).

No The dialysate pressure transducer #9 is bad (see Figure 70, page 185). Replace it.

F- 11.0.1 RESET ALARMS

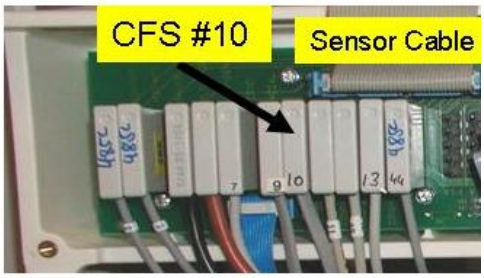
a) Press and release the 'RESET' key then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. If a TMP alarm occurs repeat the RESET sequence once again then continue.

b) Is **ACFS** 3.5 or greater?

Yes See procedure number F- 11.0.4 (page 47).

No See procedure number F- 11.0.3 (page 47).

F- 11.0.3 CHECK CFS ELECTRONICS (ACFS)



a) Referring to the Figure (right), unplug the CFS transducer's connector (labeled #10) from distribution board position labeled x10, "CFS".

b) **IMPORTANT!** To avoid time consuming error, using the screen's clock (upper right), allow up to five minutes (**ACFS** response is NOT instantaneous).

c) Does **ACFS** increase to 9 or greater?

Yes a) CAREULLY return the CFS transducer #10 to distribution board position "CFS".

b) See procedure number F- 11.0.4 (page 47).

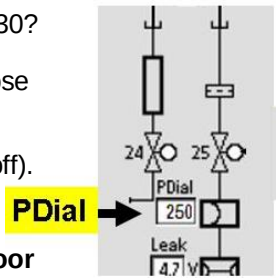
No Leaving the CFS transducer unplugged, four possibilities: 1) Bad actuator board [a]: 2) Bad sensor board [b]; 3) Bad sensor cable; 4) Bad distribution board.

[a] Swap in a known good actuator board and place the machine into Dialysis program. Call debug screen 10 and allow up to **five minutes**. If **ACFS** goes to greater than 9 the previous actuator board is bad.

[b] Swap in a known good sensor board (see Figure 4A, page 8). Enter Service Mode → Options → Hardware Options. Set 'T and C' to "Yes". Press the 'CONFIRM' key (the "x" turns blue). Place the machine into Dialysis program. Call debug screen 10 and allow up to **five minutes**. If **ACFS** = goes to greater than 9 the previous sensor board is bad.

F- 11.0.4 CHECK TMP

Call debug screen 0. Referring to the Figure (right), does the **PDIal** window read 0 +/- 30?



Yes a) **IMPORTANT!** Return the red dialyzer connector to the shunt and close the door.

b) **IMPORTANT!** Turn Dialysate Flow ON (Dialysate Flow on/off LED off).

c) See procedure number F- 11.0.5 (page 48).

No a) ACCURATELY calibrate DIALYSATE PRESSURE. **Close the shunt door when instructed per written procedure in the Calibration book!**

b) Return the dialyzer connectors to the shunt and close the door.

c) Connect to concentrate and place the machine into Dialysis program (remember to press the 'CONFIRM' key).

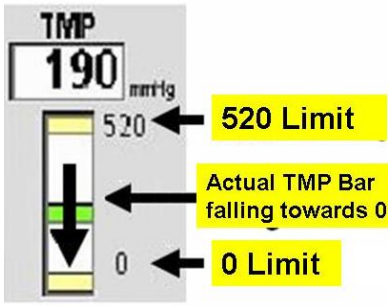
d) See procedure number F- 11.0.5 (page 48).

F- 11.0.5 CHECK FOR A LEAKING BALANCING CHAMBER VALVE

a) Call the Home screen.

b) Press and release the 'RESET' key then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. If a TMP alarm occurs, repeat the RESET sequence up to twice more then continue.

c) Referring to the Figure (right), watch the (green or red) 'actual' TMP bar for one minute. Does it fall (↓) towards the 0 Limit, and/or increase towards the 520 Limit greater than +/- 30 mmHg OR 'peg' below the 0 Limit causing a "TMP is LOW" alarm?



Yes **NOTE** this page and procedure number in case you need to return here:

a) **NOTE** nine leak tests will be performed: **1)** IOS; **2)** Balancing Chamber Valves #31 through #38. See SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

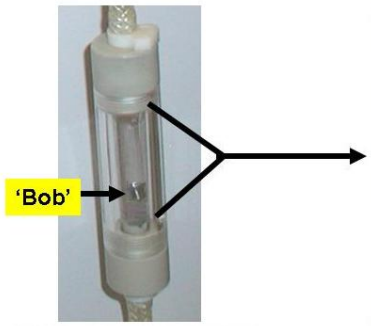
b) Replace the CFS pressure transducer #10 (see Figure 21, page 43).

No The CFS transducer #10 is bad (see Figure 21, page 43). Replace it!

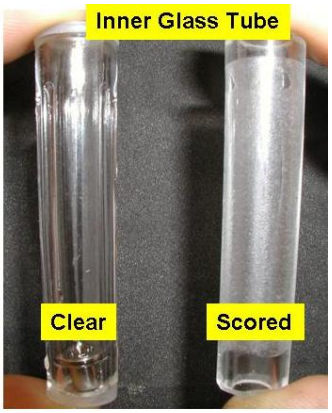
F- 14.0.0 TROUBLESHOOTING THE 'OUT OF BYPASS' CIRCUIT

a) Re-check loading pressure. If (and ONLY if) it is NOT peaking to between: 23 and 27 psi (equipped with DiaSafe® filter); 17 and 23 psi (NOT equipped with DiaSafe® filter) see procedure number F- 2.0.4 (page 18).

b) Referring the Figure (right), check the external flow indicator (#75) for scoring (inner tube appears cloudy) that may restrict 'bobs' movement. The tube is normally perfectly clear. **If (and ONLY if) scoring is located repair or replace the indicator as this may be the problem.**



External Flow Indicator



c) Plug the concentrate connectors into their rinse ports and place the machine into Rinse Program.

d) Is the external flow indicator's 'bob' rising, **at least ½ way up**, and falling?

Yes See procedure number F- 14.0.1 (page 48).

No See procedure number F- 14.0.2 (page 49).

F- 14.0.1 CHECK BYPASS FUNCTION (BYPASS LED ON)

a) Allow rinse to continue for two full minutes.

b) Press the 'Escape' key then the 'CONFIRM' key twice to return to the "Select Program" screen.

c) Connect to concentrate and return to Dialysis program (remember to press the 'CONFIRM' key).

d) From the Home screen set Dialysate flow to 800 ml/min and press the 'CONFIRM' key.

e) **IMPORTANT!** With the Bypass LED ON **CONSTANT** is the flow indicator's 'bob' rising, **at least ¼ way up**, and falling?

Yes See procedure number F- 14.0.9 (page 51).

No See procedure number F- 14.0.10 (page 52).

F- 14.0.2 CHECK VALVE #26

This IMPORTANT procedure checks if valve #26 is closing properly. A clamp is required:

a) Referring to Figure 23 (page 49), valve #26 is in one of two locations.

b) From Rinse Program, clamp valve #26 **INPUT** tubing at the location indicated in Figure 23 (page 49).

c) Does the external flow indicator's 'bob' rise, **at least ½ way up**, and fall now?

Yes Two possibilities: 1) Bad actuator board; 2) Bad valve #26 (remaining open!). **NOTE: After repair the problem that you were originally troubleshooting may still be present!**

No a) **IMPORTANT!** Remove the clamp from valve #26.

b) See procedure number F- 14.0.3 (page 49).

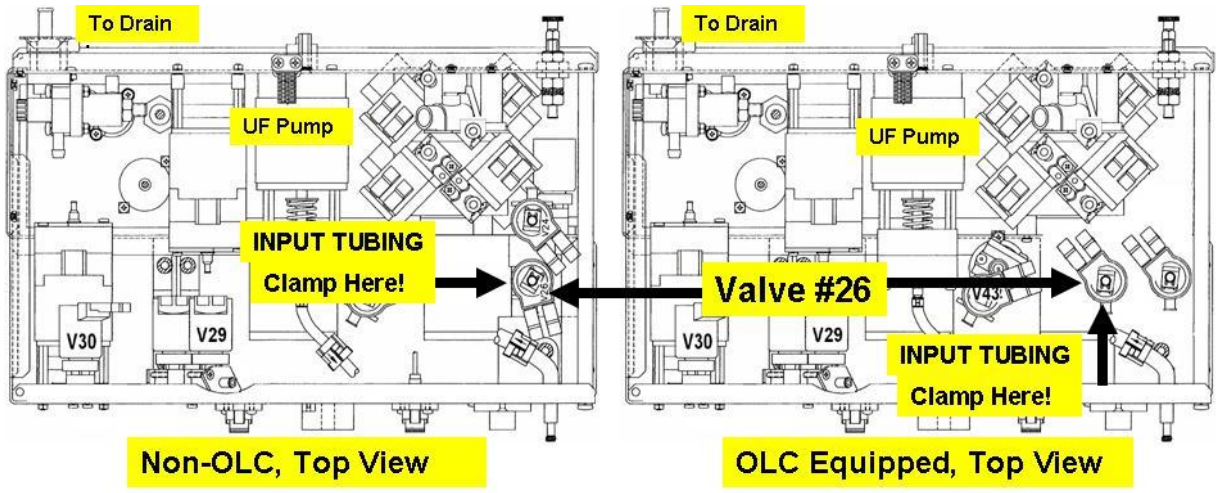
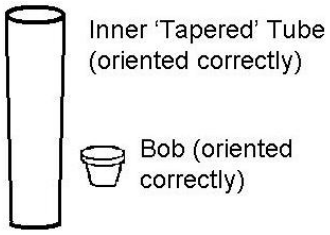


Figure 23 – Clamp Valve #26

F- 14.0.3 CHECK FOR FLOW THROUGH THE INDICATOR

This step especially important if the indicator was disassembled or replaced recently. Referring to the Figure (right), if the **inner** tube or the 'bob' is oriented incorrectly the 'bob' may not rise. Proceed accordingly:



- **The 'bob' is NOT rising:** See procedure number F- 14.0.4 (page 49).
- **The 'bob' is rising (at least some):** a) Connect to concentrate and place the machine into Dialysis program (remember to press the 'CONFIRM' key).

  b) See procedure number F- 14.0.10 (page 52).

F- 14.0.4 CHECK VALVE #24 AND THE DIASAFE® FILTER #90 (IF EQUIPPED)

a) Assuring the card cage is closed, open the shunt door. The "Cover Is Open" message presents, the screen's timer stops (and blinks), but Rinse Program continues.

b) Remove the RED dialyzer quick connector from the shunt but **do NOT shut the door!** Strong flow from the vacant shunt door port?

Yes Valve #24 and the DiaSafe® filter are okay. See procedure number F- 14.0.5 (page 50).

No a) Return the red dialyzer connector to the shunt but **do NOT shut the door** so that Rinse program remains uninterrupted.

b) See procedure number F- 14.0.6 (page 50).

F- 14.0.5 CHECK 'FROM DIALYZER' CIRCUIT FOR RESTRICTIONS

a) Press the 'Escape' key then the 'CONFIRM' key twice to return to the "Select Program" screen.

b) Referring to Figure 24 (page 50) three checks for restrictions:

Check #1: Open Dialysate Filter #73's housing (if present) and check the filter segment and tubing.

Check #2: Using a flashlight, check through the tubing to and from valve #25.

Check #3: Using a flashlight, check through the tubing between Dialysate Pressure Transducer #9 and Blood Leak Sensor #8.

c) If no restrictions were located, touch valve #25's (black) solenoid. Is it warm or hot (i.e. energized)?

Yes The actuator board is okay, Replace valve #25.

No **NOTE** that VALVE #25 (ONLY) will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

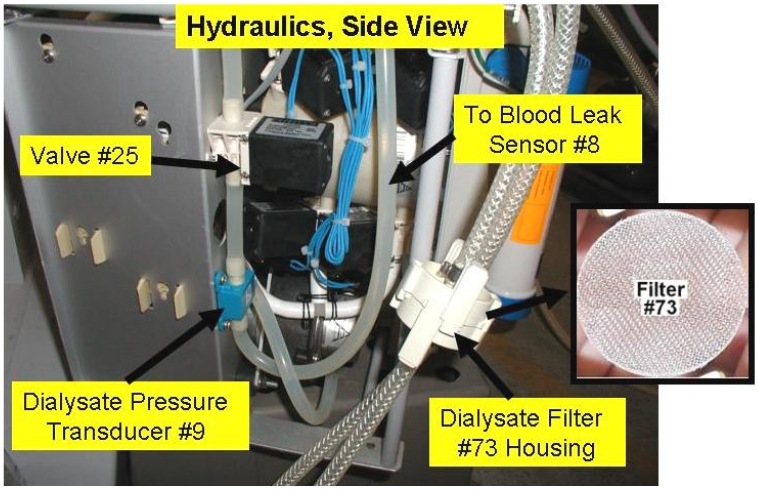


Figure 24 – Valve #25 / Pressure Transducer #9 / Dialysate Filter #73

F- 14.0.6 CHECK INPUT FLOW AT VALVE #24

a) With Rinse Program continuing, be CAREFUL HERE! Referring to Figure 25 (page 51), valve #24 is in one of two locations. Clamp and remove its **INPUT** tubing. Direct the tubing so that spillage into the machine will not occur.

b) Remove the clamp. Strong flow from valve #24's tubing?

Yes a) Remove the red concentrate connector from its rinse port to interrupt Rinse.

b) Reattach valve #24's tubing then see procedure number F- 14.0.8 (page 51).

No See procedure number F- 14.0.7 (page 51).

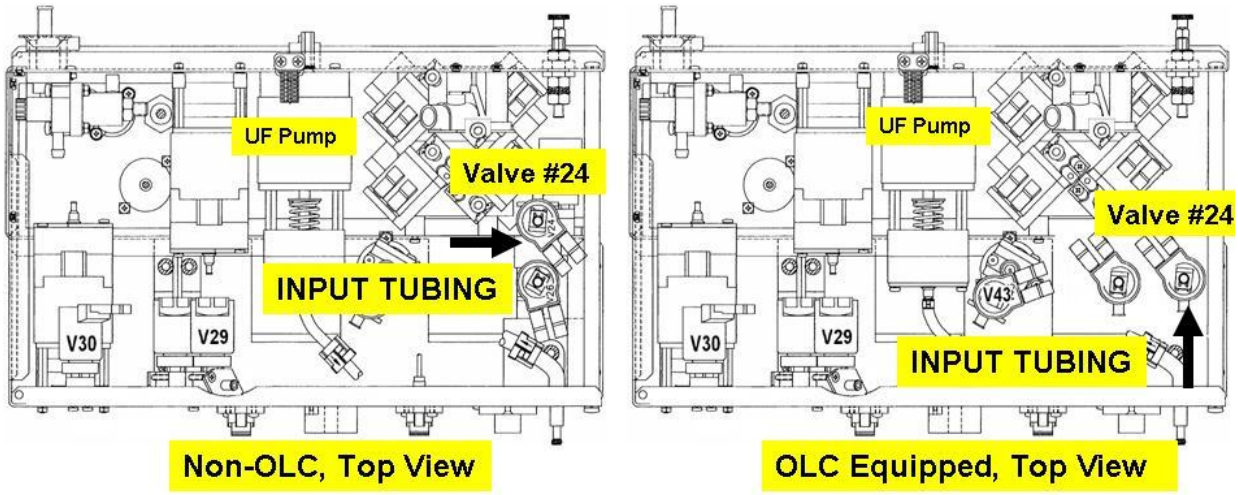


Figure 25 – Valve #24

F- 14.0.7 VERIFY DIASAFE® FILTER

a) Pull the red concentrate connector from its rinse port to interrupt Rinse.

b) Reattach the tubing to valve #24 and remove the clamp.

c) Is the machine equipped with a DiaSafe® filter?

Yes — Using a flashlight, check for tubing restrictions in the tubing, to and from the DiaSafe® filter. If no restrictions are located, replace the DiaSafe® filter.

No — Using a flashlight, check for restrictions in the INPUT tubing of valve #24.

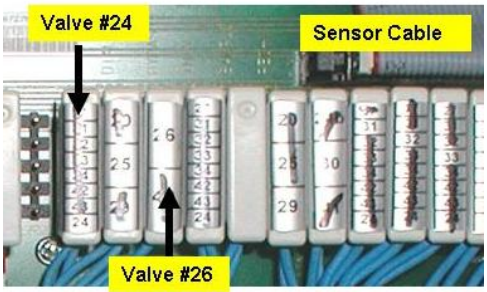
F- 14.0.8 ISOLATE ACTUATOR BOARD / VALVE #24

Referring to Figure 25 (page 51), touch valve 24's (black) solenoid. Is it warm (i.e. energized)?

Yes — The actuator board is okay. Replace valve #24.

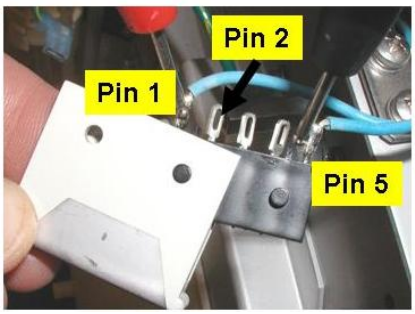
No — **NOTE** that VALVE #24 ONLY will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

F- 14.0.9 CHECK VALVES #24 AND #26



a) Referring to Figure 35 A (page 79) AND the Figure (right), CAREFULLY trace the blue wiring harness from valve #24's AND #26's distribution board connectors to their (black) solenoids to ASSURE they are NOT reversed. **If reversed this is the problem!**

b) Referring to the Figure (below, right), inside the valve's female distribution board connectors: Two checks:

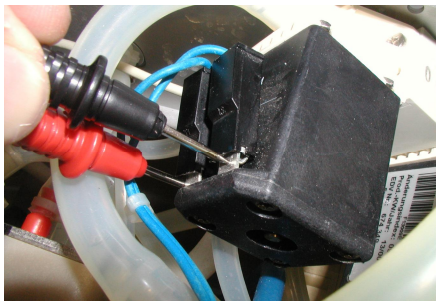


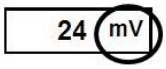
1) ASSURE valve #24 is wired between *pins 1 and 5* (top and bottom). **IMPORTANT!** If okay, return valve #24 to distribution board position labeled "V24" or "P24".

2) ASSURE valve #26 is wired between *pins 2 and 5* (second from the top and bottom). If okay, return valve #26 to distribution board position labeled "V26" or "P26". Continue to part c.

c) **IMPORTANT!** Open the shunt door (Bypass LED on).

d) With the blue wire harness remaining plugged in (see Figure right) AND with the **shunt door OPEN**, CAREFULLY measure DC voltage across valve #24's metal solenoid terminals.



e) A reading like 24 mV 

is 24 millivolts (0.024 volts).

f) Measurement 2 V (volts) DC or less?

Yes Valve #24 is bad (leaking)*****.

No The actuator board is bad***** (see Figure 4A, page 8).

*** IMPORTANT!** After repair be CERTAIN to perform FINAL CHECKS (page 10) to double check the 'bypass function'.

F- 14.0.10 CHECK FLOW 'FROM' DIALYZER

A 1000 ml graduated cylinder is required for this procedure. **BE VERY CAREFUL!**

a) Referring to Figure 24 (page 50) CAREFULLY open Dialysate Filter #73's housing (if present) and check the filter segment and tubing for restrictions. **If a restriction is located this is the problem!**

b) **VERY IMPORTANT!** Assure Dialysate Flow is ON (Dialysate Flow on/off LED off)!

c) Plug the red concentrate connector into its rinse port to call the "Select Program" screen. **WARNING! Do NOT start a Cleaning Program!**

d) **With the "Select Program" screen up, CAREFULLY** plug valve #35 into valve #30's distribution board position (labeled "V30" or "P30").

e) Remove the red dialyzer connector from the shunt and measure flow from it, into a 1000 ml graduated cylinder for 30 seconds. If no flow, **carefully double check connector placement!** Proceed accordingly:

- **400 ml or greater:** Valve #25 is okay. See procedure number F- 14.0.11 (page 52).
- **Less than 400 ml:** Check valve #25 for restrictions (see Figure 24, page 50).

F- 14.0.11 CHECK FLOW 'TO DIALYZER'

a) **IMPORTANT!** Return the red dialyzer connector to the shunt.

b) **IMPORTANT!** Valve #35 should still remain plugged into valve #30's distribution board position.

c) With the "Select Program" up, **CAREFULLY** plug valve #24 into valve #34's distribution board position ("V34").

d) Remove the blue dialyzer connector from the shunt and measure flow from it for 30 seconds. If no flow, **carefully double check connector placement!** If there is flow, two measurements are recommended! Proceed accordingly:

- **400 ml or greater:** Valve #24 and the DiaSafe® filter are okay. See procedure number F- 14.0.12 (page 53).
- **Less than 400 ml:** a) **CAREFULLY** return valve #30, #34 and #24 to their respective distribution board positions.

  b) Two possibilities: 1) Restricted DiaSafe® filter (if equipped); 2) Restricted valve # 24 (see Figure 25, page 51).

F- 14.0.12 RETURN SYSTEM TO NORMAL / CHECK FLOW ERROR

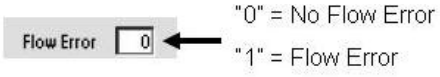
a) **CAREFULLY** return valve #30, #34 and #24 to their respective distribution board positions.

b) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

c) From the Home screen set Dialysate flow to 800 ml/min and press the 'CONFIRM' key.

d) With the Bypass LED ON constant ASSURE there is no flow through the external flow indicator.

e) Call debug screen 0. Monitor **Flow Error** for three minutes or until if **Flow Error** = 1: Proceed accordingly:



- **Flow Error = 0 (constant):** See procedure number F- 14.0.13 (page 53).
- **Flow Error = 1 (intermittent or constant):**

  a) ASSURE all valves have been plugged into the distribution board properly.

  b) Return to procedure number F- 1.0.1 (page 14).

F- 14.0.13 TROUBLESHOOT INTERMITTENT FLOW ERROR

a) **NOTE** this procedure and page number in case you need to return here then perform SECTION 19 - TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM (page 238).

b) Call debug screen 0 to monitor **Flow Error** for three minutes: Proceed accordingly:

- **Flow Error = 0 (constant):** Do NOT continue.
- **Flow Error = 1 (intermittent or constant):** Return to F- 1.0.1 (page 14).

F- 15.0.0 LOADING PRESSURE PROBLEMS

a) Close the shunt door! ASSURE the loading pressure gauge is **slammed hard** into the rinse port.

b) If attached to a portable RO assure adequate (greater than 800 ml/min), air free, incoming water flow.

c) Assuring Dialysate flow in ON (Dialysate Flow on/off LED off), if (and ONLY if) a "No Water" message presents (or has presented) itself at any time proceed to page 64, SECTION 2 - NO WATER.

d) Referring Figure 26 (page 53), from the FRONT of the hydraulics, is the DEAERATION MOTOR shaft rotating?

Yes See procedure number F- 15.0.1 (page 54).

No **NOTE** the **DEAERATION MOTOR** ONLY will be checked and proceed to page 60, TROUBLESHOOTING MOTORS

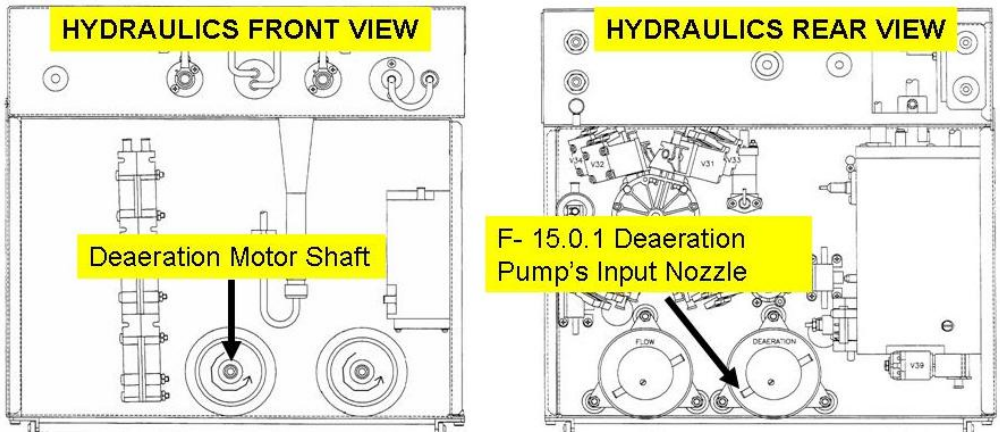


Figure 26 – DEAERATION Motor / Pump

F- 15.0.1 CHECK DEAERATION PUMP INPUT FLOW

This procedure checks flow from chamber D as supplied from chamber C through restrictor #48. **A 100 ml graduated cylinder is required**:

a) Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks) and allow one minute for the deaeration motor to stop (debug screen 1, DEAP = 255)! **IMPORTANT! Flow should be left off unless instructed otherwise!**

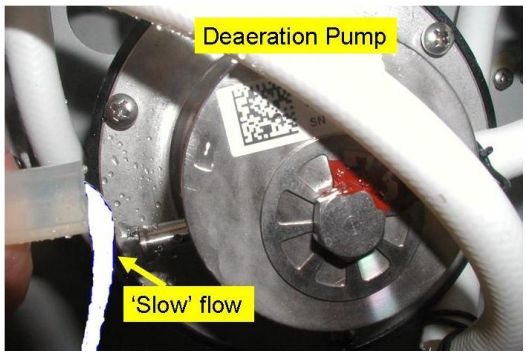
b) Referring to Figure 26 (page 53), from the REAR side of the hydraulics, remove the clear tubing from the deaeration pump's input nozzle and holding it below the pump,

c) ACCURATELY measure into a **100 ml** graduated cylinder for 30 seconds.

d) Measurement 60 ml or greater?

Yes See procedure number F- 15.0.2 (page 54).

No See procedure number F- 16.0.0 (page 56).



F- 15.0.2 HYDRO BLOCK OR HYDRO CHAMBER?

a) Reconnect the deaeration pump's tubing. **Do NOT turn flow on!**

b) Referring to Figure 27 (page 54), is the machine is equipped with the **Old Style Hydro Block** or the? **New Style Hydro Chamber**

- **Old Style Hydro Block:** See procedure number F- 15.0.3 (page 55).
- **New Style Hydro Chamber:** See procedure number F- 15.0.4 (page 55).

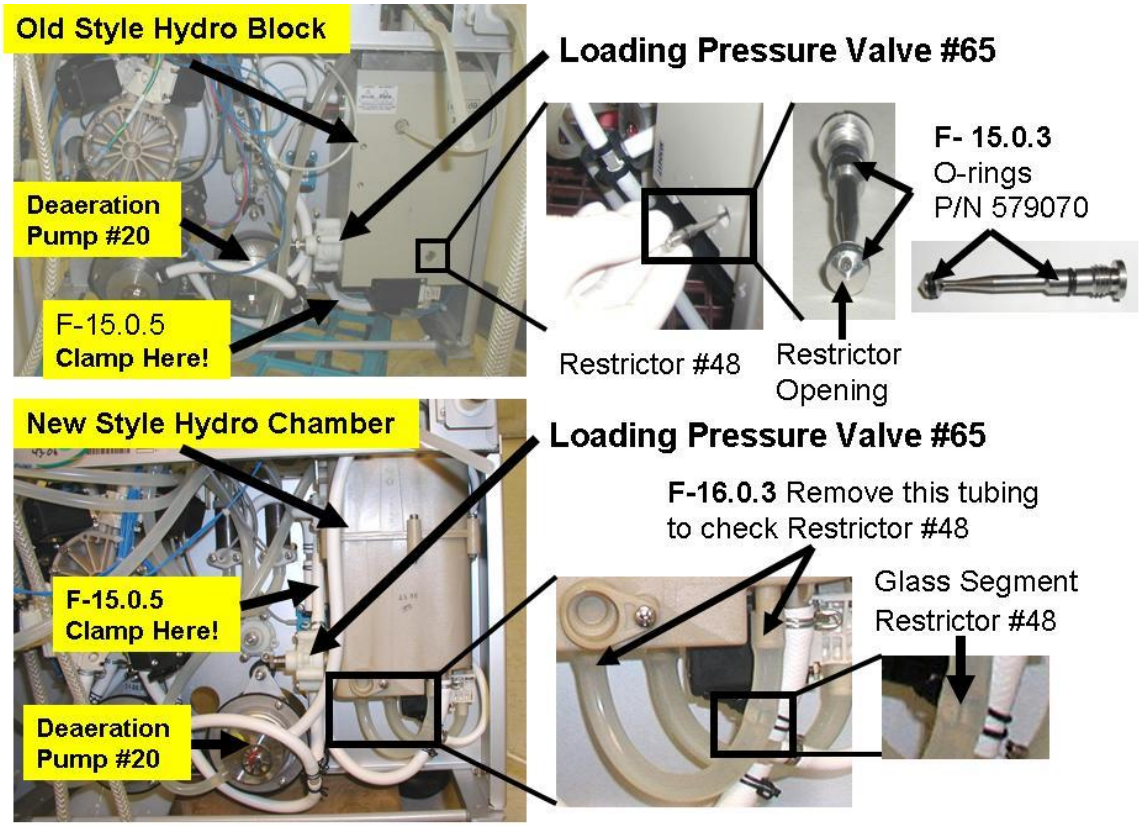


Figure 27 – Hydro Block / Hydro Chamber

F- 15.0.3 CHECK RESTRICTOR #48 O-RINGS (Old style Hydro Block only)

a) Turn the water off and clamp the vent tubing (see Figure 6, page 13).

b) Referring to Figure 27 (page 54), check or replace **both** of restrictor #48's o-rings (P/N 579070). Bad or missing o-rings affect loading pressure and should be replaced during Annual Preventative Maintenance.

c) Reinstall the restrictor and tighten until snug. **Never use an electric screwdriver!** If the restrictor does not tighten snug the threads may be stripped and this requires replacing the hydro block.

d) **IMPORTANT! Turn the water on** and **unclamp the vent tubing**.

e) See procedure number F- 15.0.4 (page 55).

F- 15.0.4 RECHECK LOADING PRESSURE

a) **IMPORTANT!** Turn Dialysate ON (Dialysate Flow on/off LED off).

b) Loading pressure may be cycling to below its minimum but is it peaking to a maximum of between: 23 and 27 psi (**equipped with DiaSafe® filter**); 18 and 22 psi (**NOT equipped with DiaSafe® filter**)?

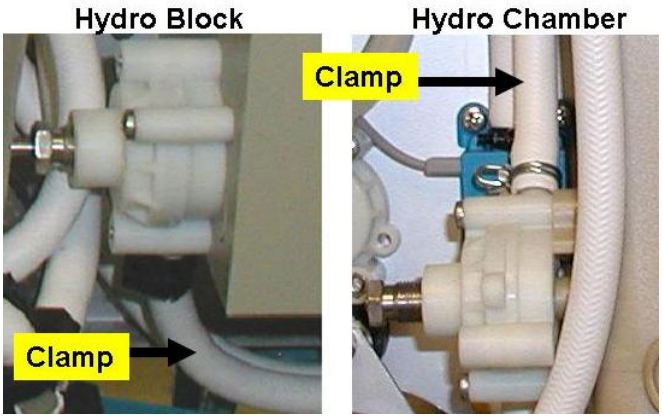
Yes See procedure number F- 18.0.0 (page 58).

No See procedure number F- 15.0.5 (page 55).

F- 15.0.5 ISOLATE DEAERATION PUMP (#20)

a) Referring to Figure 27 (page 54), this procedure will use pliers to clamp the **white tubing** BETWEEN loading pressure valve #65 and the hydro block/hydro chamber. **WARNING! Do NOT use a plastic clamp!**

b) Proceed according to how the machine is equipped (**Old Style Hydro Block** OR **New Style Hydro Chamber**):



- **Old Style Hydro Block:** The **white tubing** extends from the bottom of valve #65 (see Figure right)
- **New Style Hydro Chamber:** The **white tubing** extends from the top of valve #65 (see Figure above)

c) While watching loading pressure, TIGHTLY clamp then QUICKLY UNCLAMP the white tubing.

d) When clamped, does pressure increase to 30 psi or greater?

Yes Replace loading pressure valve #65 (see Figure 27, page 54) and calibrate DEAERATION AND LOADING PRESSURE per procedure.

No See procedure number F- 15.0.6 (page 55).

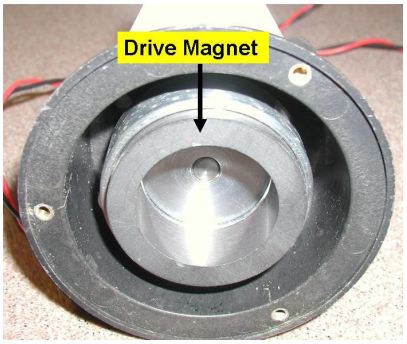
F- 15.0.6 ISOLATE DEAERATION PUMP / MOTOR

Referring to Figure 27 (page 54) to locate the deaeration pump:

a) Turn the machine off.

b) Referring to Figure (right), remove the pump head from the motor.

c) Manually spin the 'Drive Magnet' 360°. Does it rotate freely?



Yes a) Assure the 'Drive Magnet' rotates the motor shaft. It may have come uncoupled.

b) Two possibilities: 1) Bad pump; 2) Bad motor (or brushes).

No The motor is bad (brushes WON'T help).

F- 16.0.0 ELIMINATE POTENTIAL AIR LOCK

With Dialysate flow REMAINING off (Dialysate Flow on/off LED blinking):

a) Attach an empty 60 ml syringe to the deaeration pump's tubing then pull on the plunger attempting to draw water out of chamber D. **NOTE: When released, if (and ONLY if) the plunger returns strongly restrictor #48 may be plugged with debris!**

b) Remove the syringe push the air out, then repeat parts a - b. After no more than ten attempts are you able to achieve continuous flow of 60 ml (or greater) in 30 seconds?

Yes
a) An air lock was present. Re-attach the deaeration pump's tubing.
b) Turn Dialysate Flow ON (Dialysate Flow on/off LED off) and allow one minute for loading pressure to return.
c) If necessary, adjust loading pressure valve #65 per Table 1 (page 18). If (and ONLY if) unable to achieve good loading pressure return to procedure number F- 15.0.0 (page 53).
d) If an air lock reoccurs in the near future see procedure number F- 16.0.1 (page 56).

No
See procedure number F- 16.0.1 (page 56).

F- 16.0.1 HYDRO BLOCK OR CHAMBER?

With Dialysate flow REMAINING off, referring to Figure 27 (page 54), how to proceed depends on if the machine is equipped with the **New Style Hydro Chamber** or **Old Style Hydro Block**.

- **Old Style Hydro block:** See procedure number F- 16.0.2 (page 56).
- **New Style Hydro chamber:** See procedure number F- 16.0.3 (page 56).

F- 16.0.2 CHECK RESTRICTOR #48 (OLD STYLE HYDRO BLOCK)

a) Clamp the vent tubing (see Figure 6, page 13).

b) Referring to Figure 27 (page 54), check or replace **both** restrictor #48 o-rings (P/N 579070). They should be replaced during Annual Preventative Maintenance. Broken o-rings cause debris!

c) Inspect the restrictor opening. Stick a small probe through it. Is it plugged?

Yes
Clear the debris[1], remove the clamp, reinstall the restrictor, and then rinse the machine for three minutes to remove a potential air lock.

No
See procedure number F- 16.0.5 (page 57).

[1] **Recurring debris may indicate:** 1) 'Rod baffle' degradation in chamber E (see Figure 28, page 59); 2) Excessive o-ring lubrication at the restrictor o-rings; 3) O-ring debris (if the restrictor o-rings are/were broken); 4) Inadequate acid clean cycles (causing excessive bicarbonate precipitate); 5) Inadequately filtered incoming water.

F- 16.0.3 CHECK RESTRICTOR #48 (NEW STYLE HYDRO CHAMBER)

a) Clamp the vent tubing (see Figure 6, page 13) externally and at the tee back to the hydro chamber.

b) Referring to Figure 27 (page 54), remove both sides of the external clear tubing, that contains restrictor #48, a **glass segment** embedded in the tubing.

c) Attach a syringe to the tubing and push or pull on the plunger. If the plunger resists the restrictor IS plugged. Is the restrictor plugged?

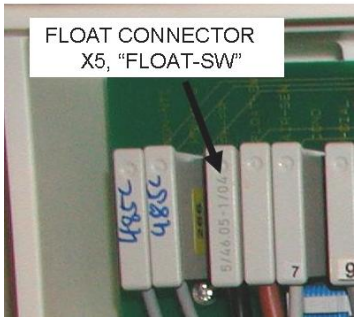
Yes
Clear the debris [2], remove the clamps, reinstall the restrictor, and then rinse the machine for three minutes to remove a potential air lock.

No
Reinstall the restrictor and see procedure number F- 16.0.5 (page 57).

[2] **Recurring debris may indicate:** 1) Inadequate acid clean cycles (causing excessive bicarbonate precipitate); 2) Inadequately filtered incoming water.

F- 16.0.5 CHECK INCOMING WATER CIRCUIT

This procedure simulates a 'down' float and should open valve #41 to flood chamber C and cause overflow from the vent tubing:



a) **IMPORTANT!** Remove the clamp(s) from the vent tubing.

b) Referring to the Figure (right), place the **274 Ω** resistor plug, from the two-resistor OLC set, into the float's distribution board position labeled "FLOAT-SW".

c) After no more than 40 seconds is there strong flow from the vent tubing?

Yes See procedure number F- 16.0.6 (page 57).

No a) ASSURE **274 Ω** resistor plug is placed properly at distribution board position labeled "FLOAT-SW". If not, repeat procedure number F- 16.0.5.

b) See procedure number F- 16.0.8 (page 57).

F- 16.0.6 PREPARE TO CHECK FLOAT

a) **CAREFULLY** return the float connector to distribution board position labeled "FLOAT-SW".

b) Connect an empty 60 ml syringe to the deaeration pump's clear INLET tubing and pull on the plunger.

c) Remove the syringe; push the air out, and repeat steps b - c. After no more than ten tries are you able to establish continuous 60 ml (or greater) in 30 seconds?

Yes See procedure number F- 16.0.7 (page 57).

No Recheck the restrictor for debris. If no debris and **assuming all above procedures have been performed correctly**, the hydro block or hydro chamber may be bad.

F- 16.0.7 CHECK THE FLOAT

a) This procedure requires up to five minutes determining if the float is working. Follow the instructions exactly to avoid the unnecessary (and difficult) labor of removing the float.

b) Allow flow to continue into a bucket for up to five minutes. Does it stop?

Yes Replace float switch #5 (see Figure 28, page 59). **IMPORTANT! After replacement place the machine into RINSE program for three minutes to eliminate an air lock.**

No a) Reattach the deaeration pump's tubing

b) Turn Dialysate flow ON (Dialysate Flow on off LED off) and allow one minute.

c) Adjust loading pressure valve #65 per Table 1 (page 18). If (and ONLY if) unable to achieve good loading pressure return to procedure number F- 15.0.0 (page 53).

d) If the problem occurs again in the near future see procedure number F- 19.0.0 (page 58).

F- 16.0.8 TROUBLESHOOT INCOMING WATER CIRCUIT

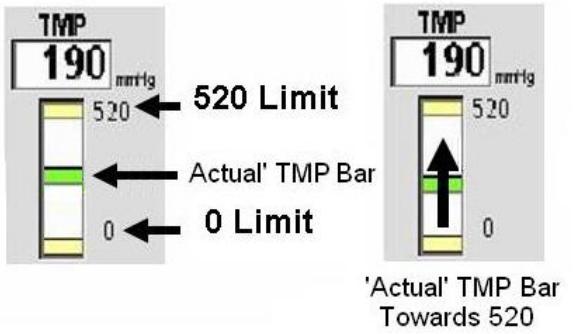
Call debug screen 0, is the dot adjacent to valve #41 blue (indicating valve #41 is open)?

Yes Assure the water is on.

No Three possibilities: 1) Bad actuator board; 2) Bad sensor board cable*****; 3) Bad distribution board.

***** The sensor cable can be checked for continuity. **NOTE** that you are checking one (1) FLOAT connection and see SECTION 17 - CHECKING SENSOR BOARD CABLE (page 228).

F- 18.0.0 CHECK TMP STABILITY



a) Call the Home screen. Referring to the Figure (right), the TMP bar graph is populated with three horizontal **bars**; yellow upper and lower alarm Limits (positioned at 520 and below 0) and an 'actual' TMP **bar** which is either red (with a TMP alarm) or green (no TMP alarm).

b) Press and release the 'RESET'' key and then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. If a TMP alarm occurs attempt the RESET sequence up to twice more then continue.

c) Watch the (green or red) 'actual' TMP bar. TMP is STABLE if (and ONLY if) it REMAINS between the 0 and 520 limits AND varies less than +/- 40 mmHg in two minutes. Proceed accordingly (three scenarios):

1) **TMP is UNSTABLE: The 'actual' TMP bar rises (↑) towards the 520 Limit AND/OR falls (↓) towards the 0 Limit, greater than +/- 40 mmHg:** See procedure number F- 18.1.0 (page 58).

2) **TMP exceeds the 520 Limit (at some point) causing a "TMP Is High" alarm:** See procedure number F- 18.1.0 (page 58).

3) **TMP is STABLE:** See procedure number F- 19.0.0 (page 58).

F- 18.1.0 TROUBLESHOOT UNSTABLE TMP

NOTE this procedure and page number in case you need to return here:

a) **NOTE** five leak tests will be performed: **1)** IOS; **2)** 'Spent Side' Balancing Chamber Valves #32, #34, #36 and #38. See SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

b) If a leak is not located, see procedure number F- 19.0.0 (page 58).

F- 19.0.0 CHECK FOR INTERMITTENT "NO WATER"

a) Place the machine into Rinse program for five minutes. Watch CAREFULLY. If (and ONLY if) an intermittent "No Water" message appears proceed to page 64, SECTION 2 - NO WATER

b) Return to Dialysis program (remember to press the 'CONFIRM' key).

c) From the Home screen, set Dialysate flow to 800 ml/min (NOT "a800") and press the 'CONFIRM' key.

d) Watch **CAREFULLY** watch the screen for five minutes. Does an intermittent "No Water" message appear?

Yes Proceed to page 64, SECTION 2 - NO WATER.

No See procedure number F- 19.0.1 (page 58).

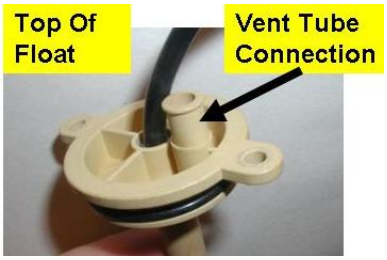
F- 19.0.1 RINSE AND VERIFY LOADING PRESSURE

Watch loading pressure for three minutes. Does it consistently fluctuate between its maximum and to NO LOWER than its minimum per Table 1 (page 18)?

Yes Acid Clean the machine.

No See procedure number F- 20.0.0 (page 59).

F- 20.0.0 PRESSURE TEST HYDRO BLOCK/HYDRO CHAMBER



This procedure pressurizes the Hydro Block/Hydro Chamber:

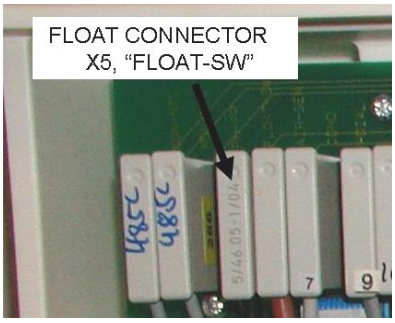
a) Referring to the Figure (right), at the top of the Hydro Block/Hydro Chamber, tie wrap the segment of vent tubing that is attached to the float.

b) Referring to the Figure (below, right), place the **274 Ω** plug, from the two-resistor OLC set, into the float's distribution position labeled "FLOAT-SW" (**3rd connector cap from the left**). This simulates a closed float switch and opens incoming water valve #41.

c) If the **274 Ω** plug is placed correctly vent tubing overflow occurs within 30 seconds.

d) **Clamp** the vent tubing. This pressurizes the Block/Chamber to approximately 20 psi (per incoming water regulator #61).

e) Check at the bottom and top of the Chamber/Block**.** Water leak located?



Yes Proceed to **page 214**, procedure number **DAIR- 7.0.0**.

No a) Return the float to distribution board position "FLOAT-SW" and unclamp the vent tubing.

b) If an air lock returns perform Acid Clean two times. If a Flow Error occurs due to bad loading pressure see part c.

c) Six possibilities: **Old Style Hydro Block ONLY:** 1) Bad restrictor o-rings or stripped fitting. **Old Style Hydro Block AND New Style Hydro Chamber:** 2) Plugged restrictor #48*; 3) Bad deaeration pump head; 4) Bad deaeration motor; 5) Bad float (see Figure 28, page 59); 6) Bad loading pressure valve #65..

***** Recurring debris may indicate: A) **Old Style Hydro Block ONLY:** 1) 'Rod baffle' degradation in chamber E (see Figure 28, page 59); 2) Excessive o-ring lubrication at the restrictor o-rings; 3) O-ring debris (if the restrictor o-rings are/were broken). B) **New Style Hydro Chamber AND Old Style Hydro Block:** 1) Inadequate acid clean cycles (causing excessive bicarbonate precipitate); 2) Inadequately filtered incoming water.

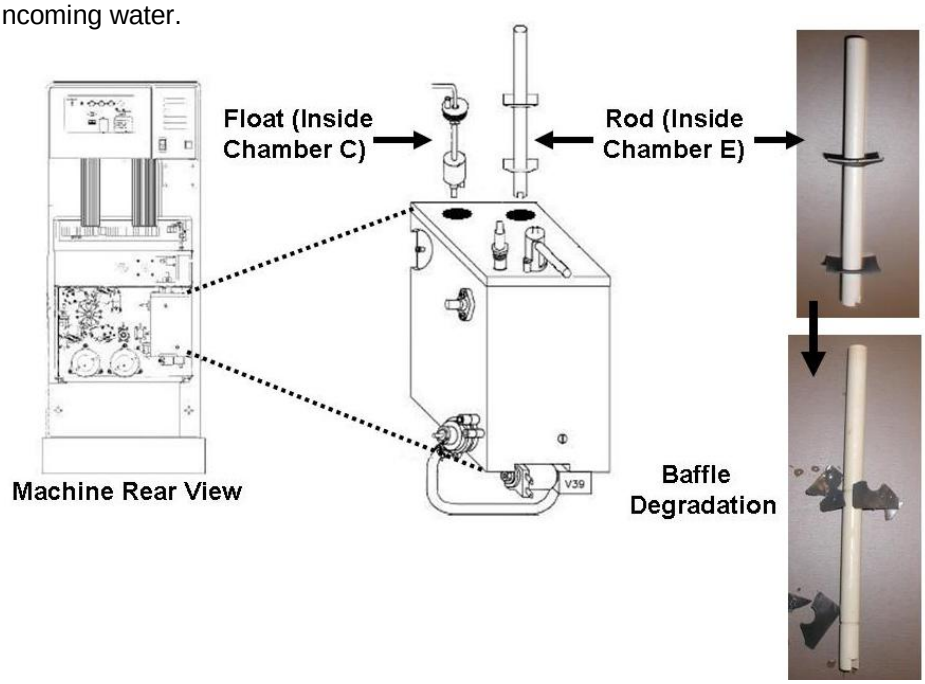


Figure 28 – Float Switch #5 and Chamber E Rod (in Old Style Hydro block ONLY)

TROUBLESHOOTING MOTORS

MOTORS- 1.0.0 MOTOR TROUBLESHOOTING

a) **IMPORTANT!** If not already done, perform INITIAL CHECKS (page 6).

b) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

c) Call debug screen 1. **FLWP** is (two possible scenarios):

1) **REMAINING 255:** Momentarily place the machine into Rinse Program then repeat procedure number MOTORS- 1.0.0 (page 60). If (and ONLY if) you return here (because **FLWP** is remaining 255) two possibilities: **1)** Bad actuator board; **2**) Bad function board.

2) **All others:** See procedure number MOTORS- 1.5.0 (page 60).

MOTORS- 1.5.0 CHECK MOTOR ROTATION

a) The procedure that brought you here NOTED the motor (**Deaeration** or **Flow**) to be checked. Proceed ONLY as directed in previously!

b) Referring to Figure 316 (page 60), the NOTED motor is (three scenarios):

1) Rotating clockwise: It's rotating backwards! See procedure number MOTORS- 2.0.0 (page 60).

2) Rotating counterclockwise (CCW): See procedure number MOTORS- 3.0.0 (page 61).

3) Not rotating in <u>either</u> direction: See procedure number MOTORS- 4.0.0 (page 62).

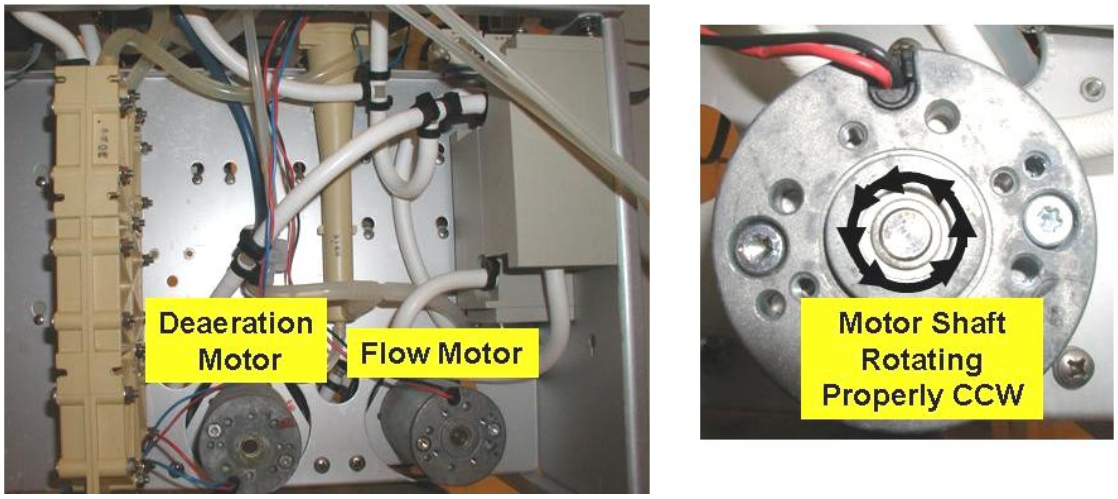


Figure 316 – Hydraulics Front View / Flow and Deaeration Motor

MOTORS- 2.0.0 MOTOR ROTATING CLOCKWISE (BACKWARDS)

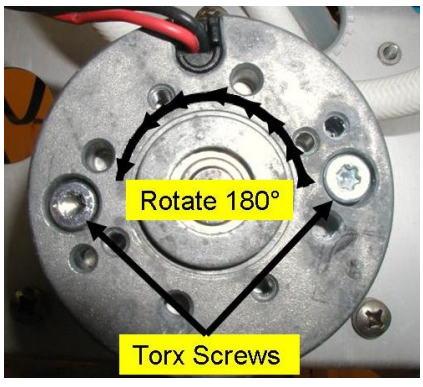
a) Turn the machine off.

b) Referring to the Figure (right), remove the Torx screws (T-25) from the cap and rotate it 180°. **<u>Do NOT remove or pull on the cap so that the brushes remain in position</u>!** Reinstall the screws.

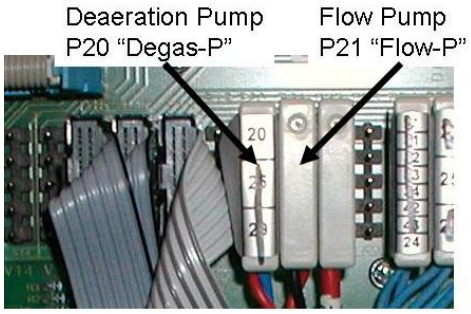
c) Place the machine into Rinse Program. Is the NOTED motor now rotating counterclockwise?

Yes Allow Rinse for three minutes to eliminate an air lock.

No <u>Return to</u> procedure number MOTORS- 1.0.0 (page 60).



MOTORS- 3.0.0 MOTOR ROTATING COUNTERCLOCKWISE



a) Turn the machine off.

b) Referring the Figure (right) and Figure 316 (page 60), trace the wires from the distribution board to the NOTED motor to assure it is connected properly.

c) Referring to Figure 29 (page 61), to verify the pump head is oriented properly; locate its 'ID Decal', either on the top or front of the head. If on the front, assure it is right side up. Is the pump head oriented correctly?

Yes See procedure number MOTORS- 3.0.1 (page 61).

No Install the pump head correctly.

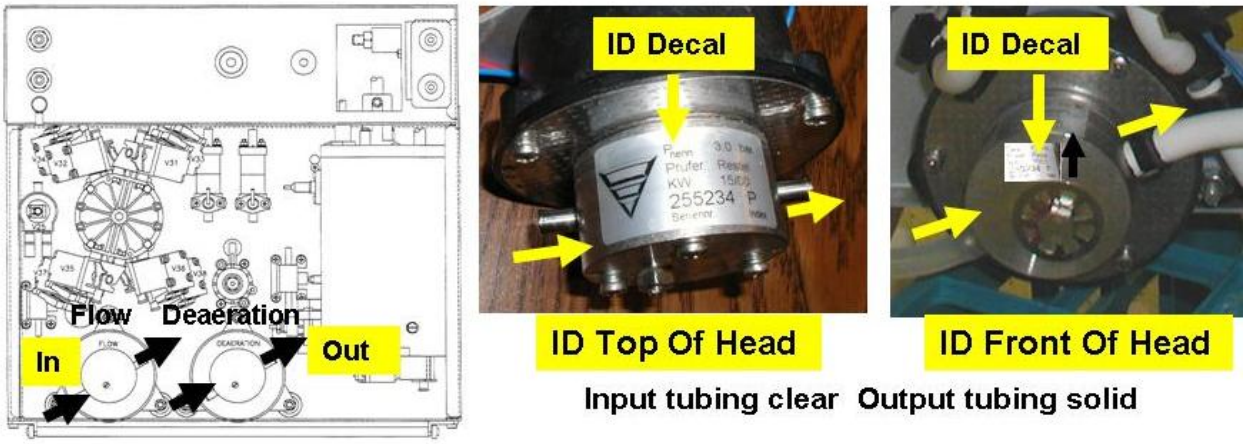


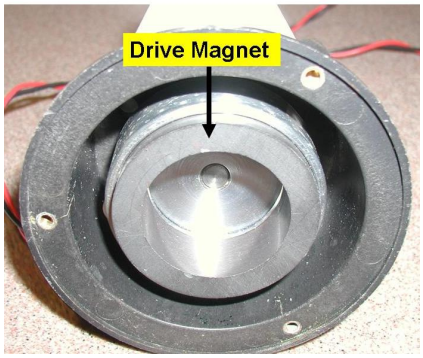
Figure 29 – Deaeration and Flow Motors Location / Orientation

NOTE: The DEAERATION motor/pump creates loading pressure and can be easily heard. It should run at a constant speed (i.e. tone). If it 'stalls' the tone decreases indicating the motor (or brushes) are bad. In this event, loading pressure decreases below minimum!

MOTORS- 3.0.1 CHECK THE MOTOR

a) Referring to the Figure (right), remove the pump head from the motor.

b) Manually spin the 'Drive Magnet' 360°. Does it rotate freely?

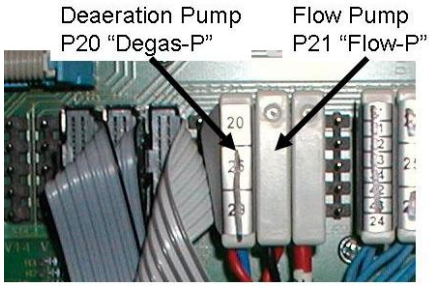


Yes a) Assure the 'Drive Magnet' rotates the motor shaft. It may have uncoupled.

b) A problem is not indicated however, the motor may be stalling intermittently due to an intermittent bad motor or brushes. Replace the brushes!

No Replace the motor (brushes WON'T help).

MOTORS- 4.0.0 CHECK DISTRIBUTION BOARD CONNECTION



Referring the Figure (right) and Figure 316 (page 60), trace the wires from the distribution board to the NOTED motor inside the hydraulics. Is the motor connected properly?

Yes See procedure number MOTORS- 4.0.1 (page 62).

No a) Plug the motor in properly and assure that it runs counterclockwise.

b) Place the machine into Rinse program for three minutes to eliminate a possible air lock.

MOTORS- 4.0.1 DISTRIBUTION BOARD / MOTOR RESISTANCE (Ω) CHECKS

a) 'Wiggle' the NOTED motor's female distribution board connector. If the motor starts there may be a bad connection inside the connector or distribution board.

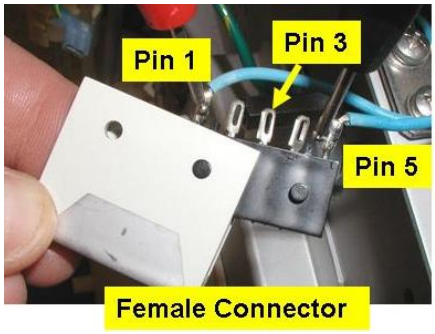
b) Tap the NOTED motor **hard** with a screwdriver handle. If it starts the brushes may be bad.

c) Being CAREFUL to NOTE the position unplug the NOTED motor from the distribution board.

d) Using a flashlight, check **inside** the vacant position for 'white' corrosion or damaged **male** pins that may cause false signals. There should be five pins.

e) Referring to the Figure (right), remove the cap from the female distribution connector: Verify good solder connections at BOTH* terminals.

* **NOTE:** The **Deaeration Motor** should be wired between pins 1 and 3; **Flow Motor,** pins 1 and 5.



f) Touch the meter leads together and subtract the meter's value from the subsequent resistance (Ω) reading!

g) Measure resistance, inside the **female connector**, between the two terminals where the wires are soldered. Is the meter's numeric AND units display indicating between 1 and 10 **Ω**? **NOTE:** A reading of "OL" = very much greater than 10 Ω!

Yes See procedure number MOTORS- 4.0.2 (page 62).

No Bad brushes or motor. After replacement, place the machine into Rinse program for three minutes to eliminate a possible air lock

MOTORS- 4.0.2 CHECK MOTOR VOLTAGE

a) **CAREFULLY** return the connector, without the cap, to its CORRECT distribution board position. **IMPORTANT!** Assure the connector is aligned correctly!

b) From the Home screen, assure Dialysate flow is set to 800 ml/min (NOT "a800").

c) Measure DC voltage, by placing the meter leads between the terminals where the wires are soldered.

IMPORTANT! The meter leads MUST make good contact with BOTH terminals! An error here may cause unnecessary and time consuming work!

d) Per Table 4 (page 63), perform the given Response based on measured voltage.

Table 4 – Motor Troubleshooting

NOTED MOTOR	DISTRIBUTION BOARD POSITION	DC VOLTAGE READING	RESPONSE
DEAERATION	P20, "DEGAS-P"	16 volts or greater	Two possibilities: 1) Bad deaeration motor 2) Intermittent 24 V harness connection (inside the power supply) See Figure 304, page 63).
		Less than 16 volts	See procedure number MOTORS- 4.0.3 (page 63)
FLOW	P21, "FLOW-P"	6 volts or greater	Two possibilities: 1) Bad flow motor. 2) Intermittent 24 V harness connection (inside the power supply). See Figure 304, page 63)
		Less than 6 volts	See procedure number MOTORS- 4.0.3 (page 63)

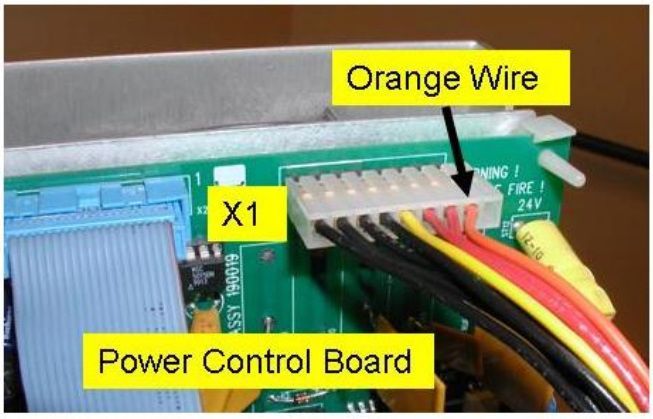


Figure 304 – 24 V Harness

MOTORS- 4.0.3 TROUBLESHOOTING BAD VOLTAGE

Three possibilities: 1) Bad actuator board. 2) Bad actuator cable [a]; 2) Bad power supply

[a] The cable can be checked for continuity. **NOTE** which motor (**FLOW** or **DEAERATION**) will be checked and proceed to page 225, SECTION 16 - CHECKING THE ACTUATOR BOARD CABLE.

SECTION 2 – "NO WATER" MESSAGE

If the float remains down for 14 seconds a "No Water" message appears:

NW- 1.0.0 NO WATER CHECKS

a) **IMPORTANT!** Before continuing, determine if circumstances such as "filling the bicarbonate tank" may be decreasing water loop (RO supply) pressure/flow**.**

b) If other machines are exhibiting "No Water" alarms check for inadequate incoming water (RO supply) pressure/flow. The machine requires no less than 20 psi.

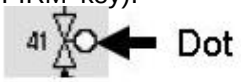
c) **VERY IMPORTANT!** Assure the vent tubing (see Figure 6, page 13) is not pinched or clamped. If it is this may be the problem!

d) Assure the station's incoming water valve is fully on **AND** the quick connector (if used) is attached properly.

e) Perform INITIAL CHECKS (page 6).

f) **IMPORTANT!** Place the machine into Dialysis Program (remember to press the 'CONFIRM' key).

g) Call debug screen 0. Referring to the Figure (right), watch valve #41's dot for one minute. Is it (three scenarios):



1. **Constant white:** Assure Dialysate flow in ON (Dialysate Flow on/off LED off). A "No Water" alarm is not present at this time!
2. **Cycling between blue and white:** See procedure number NW- 1.0.1 (page 64).
3. **Constant blue:** Constant "No Water" problem. See procedure number NW- 1.0.2 (page 65).

NW- 1.0.1 TROUBLESHOOT INTERMITTENT "NO WATER"

a) Check the incoming water filter (if present, see Figure 6, page113) and tubing for restrictions.

b) If the machine is located near the end of the water loop place it at a station where machines are NOT indicating "No Water". If "No Water" does not reoccur the problem may be at the previous station.

c) Turn the water OFF and remove the incoming (TOP) water tubing from the rear of the machine (see Figure right).

d) Turn the water ON. If attached to a portable RO assure air free incoming water flow.

e) Measure flow for one minute. It should be greater than 1000 ml. If not, check the incoming water loop (RO supply).

f) Reattach the incoming water tubing and turn the water on.

g) **Read this entire step before performing it!** Check INLET WATER PRESSURE, per Preventative Maintenance procedures, but CAREFULLY watch the gauge for three minutes. Pressure should fluctuate between a maximum and minimum. A minimum, decreasing to **8 psi or lower**, may indicate marginal incoming water (RO supply) flow. If (and ONLY if) the minimum is remaining 8 psi or greater, the **maximum** should be between 18 and 20 psi. If not, calibrate regulator #61 (see Figure 30, page 66). If unsuccessful, a bad pressure regulator #61 may be indicated.

h) See procedure number NW- 5.0.0 (page 68).

NW- 1.0.2 CHECK FOR UNRELATED ELECTRICAL FAILURE

a) Check the incoming water filter (if present, see Figure 6, page113) and tubing for restrictions

b) Assure incoming water valve (#41) is plugged into distribution board position V27, "IN-V".

c) Call debug screen 0. Watch **Valve Error**

(at the top of the screen) for 5 seconds (three scenarios):

1. **Valve Error = 0 (constant):** See procedure number NW- 1.0.3 (page 65).
2. **Valve Error = 1 (constant):** See procedure number NW- 6.0.0 (page 69).
3. **Valve Error 'blinks' to 1 but returns to 0:** See procedure number NW- 1.0.3 (page 65).

NW- 1.0.3 CONFIRM "NO WATER"

a) Turn the machine off and back on.

b) Return to Dialysis program (remember to press the 'CONFIRM' key). Call debug screen 0. Is valve #41's dot remaining constant blue?

Yes See procedure number NW- 1.0.4 (page 65).

No If "No Water" reoccurs in the near future it is intermittent. In this event, return to procedure number NW- 1.0.1 (page 64) otherwise there is no need to continue!

NW- 1.0.4 CHECK VALVE #41 ELECTRICAL FAILURE

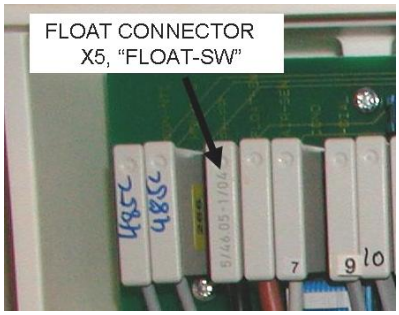
Call debug screen 1. Is **VERR** (lower right) greater than 5?

Yes See procedure number NW- 1.0.5 (page 65).

No See procedure number NW- 2.0.0 (page 66).

> Valve solenoid circuit malfunctions cause 'Valve Errors'. A digital counter (VERR), counts up to its maximum of 255. If a Valve Error is NOT present VERR remains constant between 0 and 5.

NW- 1.0.5 CONFIRM ELECTRICAL PROBLEM AT VALVE #41



a) **VERR** should be increasing at one unit per second **AND** not = 255 (its maximum)!

b) Referring to the Figure (right), unplug the float from distribution board position 'FLOAT-SW (**3rd connector, 4th position from the left**). Does **VERR** continue to increase?

Yes Leave the float unplugged for now. A valve error is present but NOT at valve #41. **NOTE** the machine is in DIALYSIS PROGRAM then proceed to page 81, TROUBLESHOOTING VALVE ERRORS.

No a) Return the float to distribution board position "FLOAT-SW" (**4th position from the left**). Confirm that **VERR** is increasing again (and NOT = 255, its maximum).

b) Valve #41 is causing a Valve Error. **NOTE** the machine is in DIALYSIS PROGRAM then proceed to page 81, TROUBLESHOOTING VALVE ERRORS.

NW- 2.0.0 CHECK INCOMING WATER PRESSURE

This procedure uses a pressure (psi) gauge to check incoming water pressure. **IMPORTANT!** ASSURE the gauge reads 0 psi before installing it!

a) **IMPORTANT!** Turn the water off.

b) Referring to Figure 30 (page 66), tee the gauge at the output side of Inlet Pressure Regulator #61.

c) **IMPORTANT!** Turn the water on!

d) Referring to Figure 30 (page 66), using pliers, (i.e. do **NOT** use a plastic clamp) TIGHTLY clamp the white tubing after the gauge. Is pressure greater than 18 psi?

Yes Leaving the gauge in place see procedure number NW- 3.0.0 (page 67).

No Assure the water in **ON** before continuing! See procedure number NW- 2.0.1 (page 66).

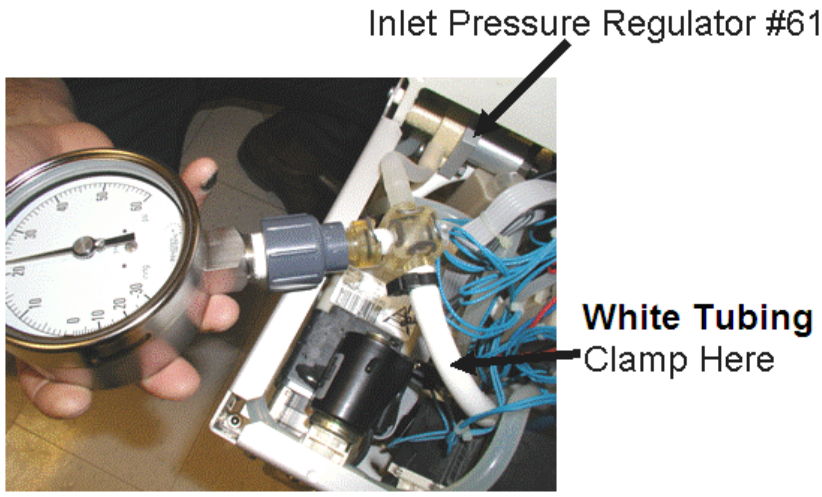


Figure 30 – Hydraulics TOP View / Inlet Pressure Regulator #61

NW- 2.0.1 CHECK INCOMING WATER

A 1000 ml graduated cylinder (or larger) is required for this procedure:

a) Remove the clamp (the pliers)!

b) **IMPORTANT!** Turn the water off!

c) Referring to the Figure (right), at the rear of the machine, remove the incoming water (TOP) tubing.

d) **IMPORTANT!** Turn the water on.

e) Measure flow from the tubing for one minute. 1000 ml or greater?

Yes Turn the water off then see procedure number NW- 2.0.2 (page 67).

No Three possibilities: 1) Restricted inlet water filter (if present, see Figure 6, page 13); 2) Restricted incoming water tubing; 3) Low incoming water flow/pressure (from the RO).

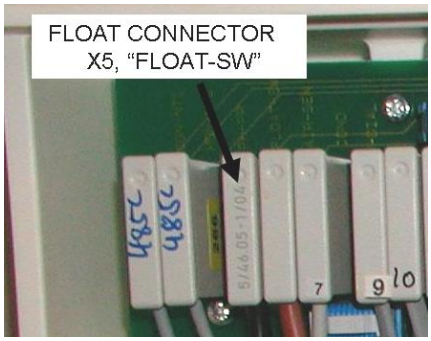
NW- 2.0.2 CHECK PRESSURE REGULATOR #61

a) Reattach the incoming water tubing. **IMPORTANT!** Turn the water on.

b) **Read this entire step before performing it!** Check INLET WATER PRESSURE, per Preventative Maintenance procedures, but CAREFULLY watch the gauge for three minutes. Pressure should fluctuate between a minimum and maximum. The minimum, decreasing to **8 psi or lower**, indicates marginal incoming water (RO supply) pressure. If (and ONLY if) the minimum is remaining 8 psi or greater, the maximum should be between 18 and 20 psi. If not, calibrate regulator #61 (see Figure 30, page 66). If unsuccessful a bad regulator #61 is indicated.

NOTE: Regulator #61 controls **maximum** pressure when valve #41 is closed, incoming water (RO supply) flow determines **minimum pressure** when valve #41 is open.

NW- 3.0.0 CHECK FLOAT (#5) SIGNAL



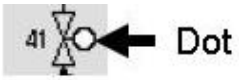
a) Remove the clamp (the pliers).

b) Turn the water off.

c) Referring to the Figure (right), place the **274 Ω** resistor plug, from the two-resistor OLC set, into the float's distribution board position labeled "FLOAT-SW" (**3rd connector from the left**).

c) This simulates a 'closed' float switch and should call for water.

d) Call debug screen 0. Referring to the Figure (right) is valve #41's dot constant **blue** indicating the valve is supposed to be open?



Yes Leaving the resistor plug in place, see procedure number NW- 4.0.0 (page 67).

No a) ASSURE the **274 Ω** resistor plug is placed properly before continuing! If not repeat procedure number NW- 3.0.0 (page 67), from part c

b) Four possibilities: 1) Bad actuator board; 2) Bad sensor cable*; 3) Bad distribution board; 4) Bad motherboard.

* The cable can be checked for continuity. **NOTE** that one (1) FLOAT connection will be checked and proceed to page 228, SECTION 17 - CHECKING THE SENSOR BOARD CABLE.

NW- 4.0.0 CHECK FOR WATER INLET

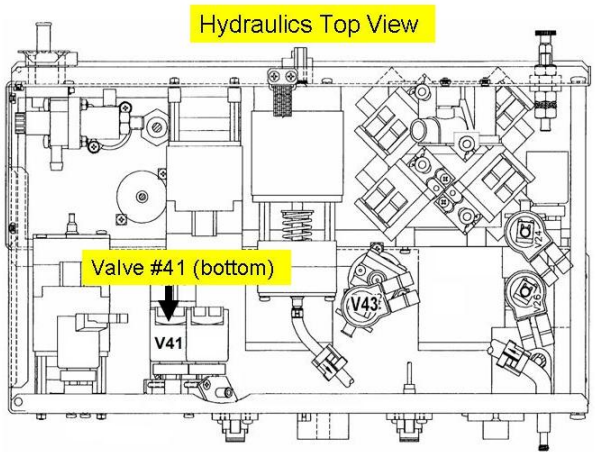
a) Place a bucket under the vent tubing to capture possible overflow.

b) **IMPORTANT!** Turn the water on. Valve #41 should be open and allowing water into the machine. After no more than 45 seconds is there overflow from the vent tubing?

Yes See procedure number NW- 5.0.0 (page 68).

No See procedure number NW- 4.0.1 (page 68).

NW- 4.0.1 ISOLATE VALVE #41 / ACTUATOR BOARD



Referring to the Figure (right), touch valve #41's (black) solenoid. Is it warm (i.e. energized)?

Yes The actuator board is okay. Replace valve #41.

No **NOTE** that VALVE #41 (ONLY) will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

NW- 5.0.0 CHECK FLOAT AND VALVE #41

A 1000 ml graduated cylinder (or larger) is required for this procedure:

a) **IMPORTANT!** Turn the water off!

b) Referring to Figure 31 (page 68), remove the clear tubing that **vertically** enters the **top** of the hydro block/ hydro chamber (from valve #41). **CAUTION! Do NOT remove the vent tubing**!

c) Direct the tubing opening into the cylinder.

d) **IMPORTANT!** Turn the water on and measure flow for one minute. Greater than 800 ml?

Yes See procedure number NW- 5.1.0 (page 68).

No Low incoming water (RO source) flow or a restriction at, to or from valve #41 is indicated.

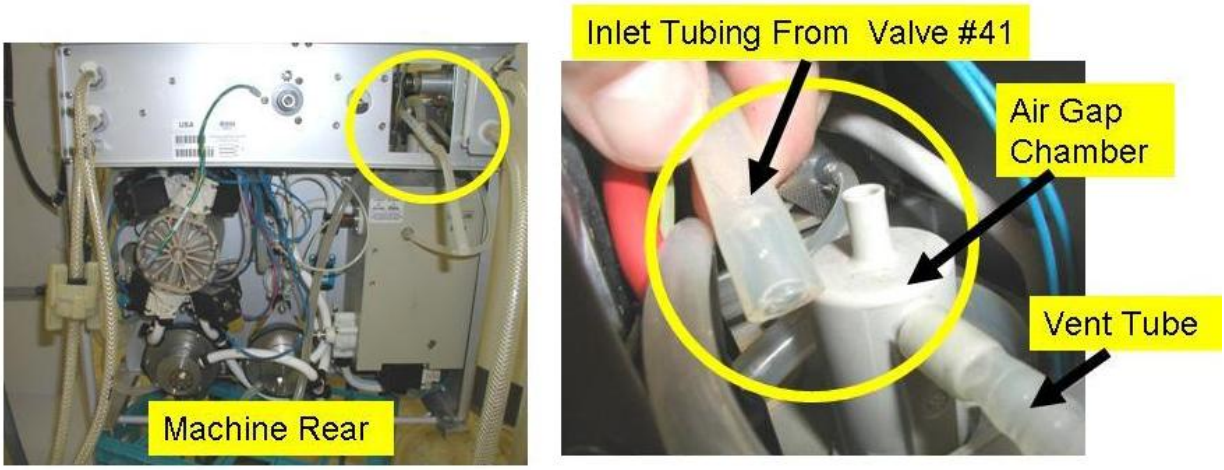
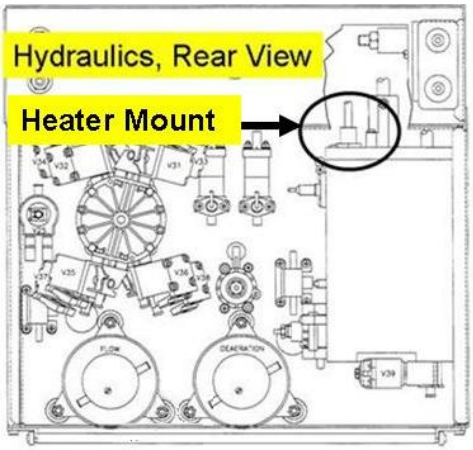


Figure 31 – Inlet Water Tubing

NW- 5.1.0 CHECK WATER SYSTEMS



a) Turn the water off and reattach the tubing.

b) CAREFULLY return the float to distribution board position labeled "FLOAT-SW" (**4th position from the left, BE CAREFUL to avoid the empty position on the left**)

c) Turn the machine off.

d) Referring to the Figure (right), remove the heater and check its port into the top of the hydroblock/hydrochamber for heat related damage (i.e. melting). If (and ONLY if) damage is located it will be necessary to replace the hydroblock/hydrochamber.

e) Reinstall the heater.

f) **IMPORTANT!** Turn the water ON.

g) Turn the machine on and return to Dialysis program (remember to press the "CONFIRM' key).

h) If the No Water" message in NOT occurring at the 500 ml/min set Dialysate flow to 800 ml/min (and press the 'CONFIRM' key) then allow three minutes. A "No Water" message occurring at 800 ml/min but NOT at 500 ml/min may indicate inadequate incoming water flow **O**R an intermittent bad float switch (see Figure 28, page 59).

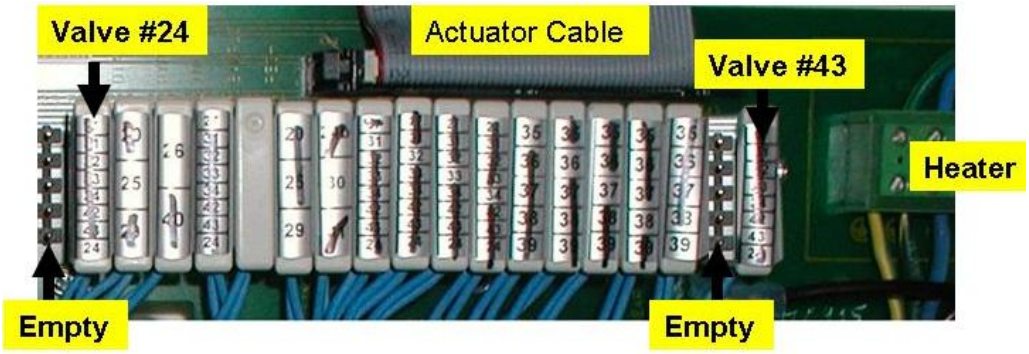
NW- 6.0.0 CHECKS VALVE #24 AND #43

a) Turn the machine off.

b) Referring to the Figure (below), are valves #24 AND #43 plugged into their correct distribution board positions (labeled "V24" or "P24" = valve #24; labeled "V43" or "P43" = valve #43)?

Yes Proceed to **page 24**, procedure number F- 4.3.0.

No Plug the valve(s) in correctly then see procedure number NW- 6.1.0 (page 69).



NW- 6.1.0 VERIFY PROBLEM

a) Return to Dialysis program (remember to press the 'CONFIRM' key)

b) Allow up to two minutes.

c) Does the "No Water" message reappear?

Yes Return to procedure number NW- 1.0.0 (page 64), step g.

No Valve #24 and/or #43 were plugged in incorrectly causing the "No Water" message.

SECTION 3 - FLOW ERRORS IN CLEANING / DISINFECTION PROGRAMS

These procedures troubleshoot Flow Errors that are occurring in Heat Disinfect, Rinse, Acid Clean, Chemical/Rinse or Chemical/Dwell. Messages can be "Flow Error" and/or "Flow Inlet Error" and/or "Flow Recirc Error 1" which occurs specifically in Heat Disinfect.

During these procedures you MAY be asked to place the machine into Dialysis program however if the "Select Program" screen's Dialysis' button is gray only 'Rinse' is allowed. In this event (ONLY), swap in a function board from a known working machine. Enter Service Mode → Options → Hardware Options. Select "Yes" for T and C. Press the 'CONFIRM' key (the 'x' turns blue). When troubleshooting is complete return both function boards to the original machines.

A) **IMPORTANT! ASSURE** the vent tubing (see Figure 6, page 13) is not clamped or pinched. **If the vent tubing is restricted this may be the problem!**

B) If (and ONLY if) a "No Water" message appears at **ANY TIME** proceed to page 64, SECTION 2 - NO WATER.

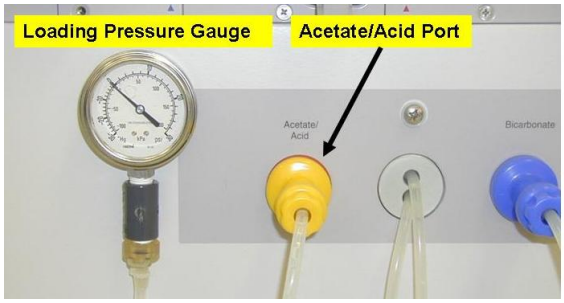
C) If (and ONLY if) tubing 'blows' off or check valves 'blow apart' or large hydraulic water leaks are present valve #29 may be sticking closed! In this event (ONLY) see procedure number CLEAN- 4.0.0 (page 74).

D) Proceed accordingly:

- **Flow Error occurring in Heat Disinfect:** See procedure number CLEAN- 1.0.0 (page 70)
- **Flow Error occurring OTHER than in Heat Disinfect:** See procedure number CLEAN- 3.0.0 (page 73).

CLEAN- 1.0.0 CHECK LOADING PRESSURE

CAUTION! Hydraulic surfaces and fluids are HOT!



a) Assuring the loading pressure gauge (with yellow connector) reads 0 psi before inserting it, **SLAM** it into the Acetate/Acid port (see Figure, right). **The screen MAY say "Interrupted". This is okay.**

b) Is pressure peaking to 18 psi or greater?

Yes a) Return the red concentrate connector to its rinse port.

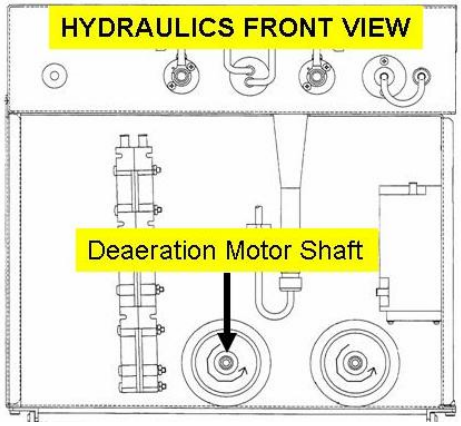
b) **IMPORTANT!** If the screen reads "Interrupted" restart Heat Disinfect.

c) See procedure number CLEAN- 3.0.0 (page 73).

No See procedure number CLEAN- 1.0.2 (page 70).

CLEAN- 1.0.2 CHECK DEAERATION MOTOR

Referring to the Figure (right), is the Deaeration motor shaft rotating?



Yes See procedure number CLEAN- 1.0.3 (page 71).

No See procedure number CLEAN- 2.0.0 (page 72).

CLEAN- 1.0.3 HYDRO BLOCK / HYDRO CHAMBER

Referring to Figure 32 (page 71), is the machine equipped with the **Old Style Hydro Block** or **New Style Hydro Chamber**?

- **Old Style Hydro Block:** See procedure number CLEAN- 1.0.4 (page 71).
- **New Style Hydro Chamber:** See procedure number CLEAN- 2.0.0 (page 72).

CLEAN- 1.0.4 CHECK DEAERATION RESTRICTOR (OLD STYLE HYDROBLOCK)

a) Turn the machine off and clamp the vent tubing.

b) Referring to Figure 32 (page 71), remove the deaeration restrictor #48 fitting.

c) Check or replace **BOTH** restrictor o-rings (P/N 579070). These rings should be replaced during Annual Preventative Maintenance. **Bad o-rings will cause this problem!**

d) Reinstall the restrictor until it is snug. NEVER use an electric screwdriver or over tighten as the threads may strip. If the restrictor does not tighten snug it may be stripped and this requires **replacing the hydro block**.

e) **IMPORTANT!** Unclamp the vent tubing.

f) See procedure number CLEAN- 2.0.0 (page 72).

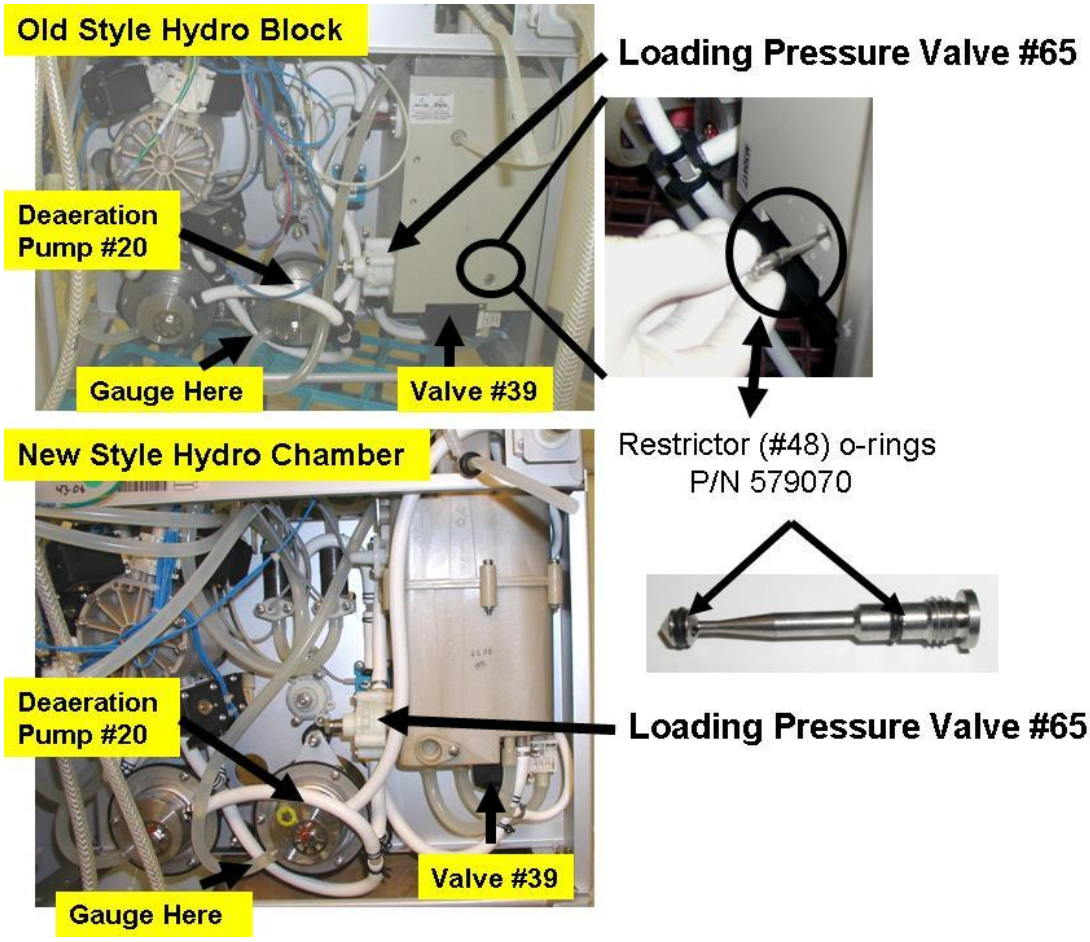


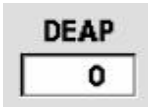
Figure 32 - Old Hydro block / New Hydro chamber

CLEAN- 2.0.0 CHECK DEAP

These procedures check for a Temperature-related problem:

a) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

b) Call debug screen 1. **DEAP** (upper right) is (three possible scenarios):



1) **Greater than 75:** See procedure number CLEAN- 2.0.1 (page 72)

2) **Less than 40:** See procedure number CLEAN- 2.0.1 (page 72)

3) **Between 75 and 40:** **NOTE** (for use later) that it is NOT necessary to adjust **DEAP** then see procedure number CLEAN- 2.0.2 (page 72).

CLEAN- 2.0.1 SET DEAP

a) **There is NO need to install gauges!** Enter Service Mode → Calibrate Hydraulics → Deaeration.

b) Select the [Pump Rate] data box. The data box turns bright yellow.

c) Set the [Pump Rate] data box to "180".

d) **IMPORTANT!** Press the 'CONFIRM' key. The data box turns pale yellow. This sets **DEAP** to = 75

e) **NOTE** (for use later) that **DEAP** had to be adjusted!

f) See procedure number CLEAN- 2.0.2 (page 72).

CLEAN- 2.0.2 CHECK DEAERATION PUMP

a) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

b) **IMPORTANT!** From the Home screen, and **patiently** allow Temperature to fall below 40° C.

c) **SLAM** the loading pressure gauge it into the Acetate/Acid port.

d) Is pressure peaking to a maximum of between: 23 and 27 psi (**equipped with DiaSafe® filter**); 18 and 22 psi (**NOT equipped with DiaSafe® filter**)?

Yes See procedure number CLEAN- 2.0.3 (page 72).

No Proceed to **page 18**, procedure number **F- 2.0.4**.

CLEAN- 2.0.3 CHECK VALVE #39

a) Turn Dialysate flow off and allow one minute for the Deaeration motor to stop (screen 1, **DEAP** = 255).

b) Referring to Referring to Figure 32 (page 71), attach the deaeration gauge between the inlet (clear tubing) and the deaeration pumps input nozzle. **Assure the gauge reads 0 inHg before attaching it**.

c) **IMPORTANT!** Turn Dialysate flow ON (Dialysate Flow on/off LED off).

d) Verify that gauge pressure is between -22 and -25 inHg.

e) Place the machine into **Rinse** Program. Does gauge pressure remain between -22 and -25 inHg?

Yes Valve #39 is remaining closed! See procedure number CLEAN- 2.0.4 (page 73).

No Normally between 0 and -15 in Hg, Valve #39 is open:

a) Turn the machine off. If (and ONLY if) hydro block/hydro chamber heat damage was located above replace it now then place the machine in Heat Disinfect.

b) See procedure number CLEAN- 2.0.5 (page 73).

CLEAN- 2.0.4 ISOLATE VALVE #39 / ACTUATOR BOARD

a) **IMPORTANT!** Allow Rinse program to continue for ten minutes.

b) Referring to Figure 102 (page 246), valve #39 is mounted to the bottom of the hydro block or hydro chamber. Touch valve #39's (black) solenoid. Is it warm (i.e. energized)?

Yes The actuator board is okay. Valve #39 is bad.

No **NOTE** that VALVE #39 (ONLY) will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

CLEAN- 2.0.5 DEAP ADJUSTED?

As **NOTED** above was it necessary to adjust **DEAP**?

Yes See procedure number CLEAN- 2.0.6 (page 73).

No Three possibilities (see Figure 32, page 71): 1) Bad deaeration pump head; 2) Bad deaeration motor (try brushes); 3) Bad loading pressure valve #65. **IMPORTANT!** After repair see procedure number CLEAN- 2.0.7 (page 73).

CLEAN- 2.0.6 VERIFY PROBLEM

Place the machine into Heat Disinfect. Three scenarios:

1) **Heat Disinfect times out (completes) successfully:** See procedure number CLEAN- 2.0.7 (page 73).

2) **A Flow Error returns AND the deaeration motor STOPS rotating:** Two possibilities (see Figure 32, page 71): 1) Bad deaeration pump head; 2) Bad deaeration motor (try brushes); **IMPORTANT!** After repair see procedure number CLEAN- 2.0.7 (page 73).

3) **A Flow Error returns AND the deaeration motor does NOT STOP rotating:** Check loading pressure. Is it peaking to 18 psi or greater?

Yes a) Return the red concentrate connector to its rinse port.

b) **IMPORTANT!** If the screen reads "Interrupted" restart Heat Disinfect.

c) See procedure number CLEAN- 3.0.0 (page 73).

No Three possibilities (see Figure 32, page 71): 1) Bad deaeration pump head; 2) Bad deaeration motor (try brushes); 3) Bad loading pressure valve #65. **IMPORTANT!** After repair see procedure number CLEAN- 2.0.7 (page 73).

CLEAN- 2.0.7 CHECK DEAERATION AND LOADING PRESSURE

Check DEAERATION AND LOADING PRESSURE per Preventative Maintenance Procedures and calibrate if necessary. **NOTE: The Calibration screen's [Pump Rate] data box MUST be between 180 and 215**

CLEAN- 3.0.0 CHECK VALVE CIRCUITS (VERR)

Call debug screen 1. Is **VERR** (lower right corner) greater than 5?

Yes See procedure number CLEAN- 3.0.1 (page 73).

No See procedure number CLEAN- 4.0.0 (page 74).

CLEAN- 3.0.1 CHECK VERR IN DIALYSIS PROGRAM

Any valve circuit can cause valve errors. These procedures isolate them:

a) Turn the machine off then back on (to reset **VERR**).

b) Return the concentrate connectors to concentrate and place the machine into Dialysis program (remember to press the 'CONFIRM' key).

c) **IMPORTANT!** Allow 20 seconds.

d) Call debug screen 1. Is **VERR** greater than 5?

Yes **NOTE** the machine is in DIALYSIS PROGRAM then proceed to page 81, TROUBLESHOOTING VALVE ERRORS.

No See procedure number CLEAN- 3.0.2 (page 74).

CLEAN- 3.0.2 CHECK VERR IN HEAT DISINFECT (VALVE #39)

a) Turn the machine off then back on (to reset **VERR**).

b) Place the machine into Heat Disinfect and (IMPORTANT!) allow three minutes.

c) Call debug screen 1. Is **VERR** greater than 5?

Yes **NOTE** the machine is in HEAT DISINFECT then proceed to page 81, TROUBLESHOOTING VALVE ERRORS to check **valves #29, #39 and #43**

No See procedure number CLEAN- 3.0.3 (page 74).

CLEAN- 3.0.3 CHECK VERR IN HEAT DISINFECT (VALVES #43, #29)

IMPORTANT! Allow four minutes so that all valves cycle open! Is **VERR** greater than 5?

Yes **NOTE** the machine is in HEAT DISINFECT then proceed to page 81, TROUBLESHOOTING VALVE ERRORS to check **valves #29, #39 and #43**

No See procedure number CLEAN- 4.0.0 (page 74).

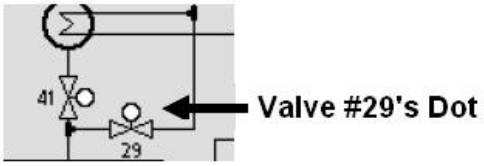
CLEAN- 4.0.0 VERIFY RECIRC FLOW (VALVE #29)

CAUTION! If the machine is in HEAT DISINECT hydraulic tubing, fluids and surfaces are hot!

a) To prevent external leaks open the UF sample port and direct the tubing output into a bucket.

b) Call debug screen 0.

c) Referring to the Figure (right), CAREFULLY watch valve #29's adjacent dot. It may be REMAINING blue or it may be cycling from white to blue approximately every 100 seconds and, in this event, valve #29's dot is blue for 9 seconds ONLY.



d) When the dot is blue valve #29 is supposed to be open. Proceed accordingly:

- **Valve #29 dot blue constant:** See procedure number CLEAN- 4.1.0 (page 74)
- **Valve #29 dot cycling between white and blue:** See procedure number CLEAN- 4.2.0 (page 75)

CLEAN- 4.1.0 CHECK VALVE #29 (ON CONSTANT)

Referring to the Figure (right), is the external flow indicator's (#75) 'bob' rising at least ¼ way up?

Yes See procedure number CLEAN- 5.0.0 (page 76).

No This procedure checks if valve #29 is opening. Referring to Figure 33, (page 75) a syringe, with a piece of tubing attached, that will fit snugly onto valve #29's input nozzle is required:

a) Referring to Figure 33, (page 75) CLAMP and remove the tubing from valve #29's nozzle.

b) Attach the syringe tubing to the empty nozzle. If the valve is open you should be able EASILY push through it with no resistance (three scenarios):

1) **Can push through but with <u>significant</u> resistance:** Replace valve #29.

2) **Cannot push through at all:** Four possibilities: 1) Bad actuator board; 2) Bad valve #29 and/or its blue wire harness; 3) Bad actuator cable; 4) Bad distribution board.

3) **Can EASILY push through:** Reattach valve #29's tubing and remove the clamp. See procedure number CLEAN- 5.0.0 (page 76).

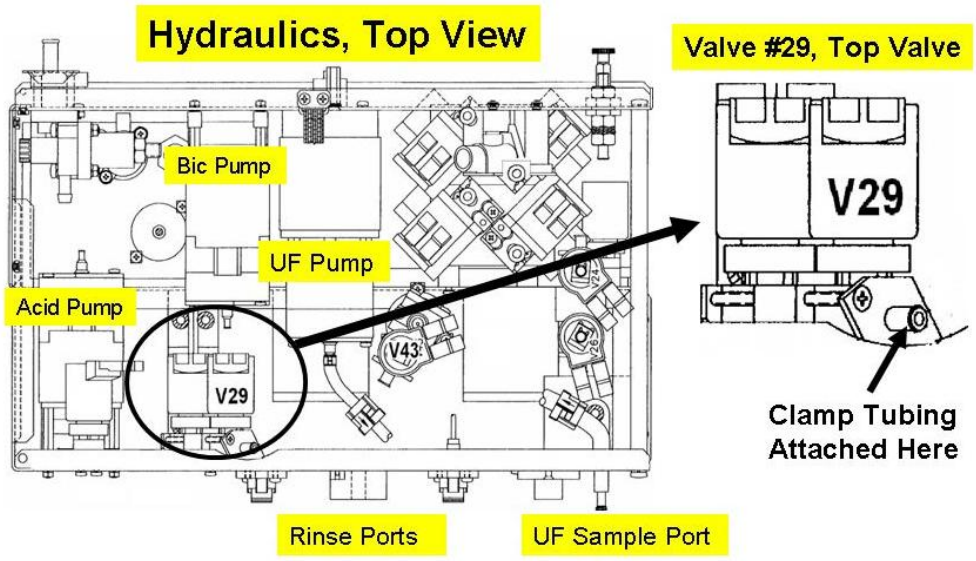


Figure 33 – Valve #29 Location

<u>CLEAN- 4.2.0 CHECK VALVE #29 (CYCLING WHITE TO BLUE)</u>

This procedure checks if valve #29 is opening. Referring to Figure 33 (page 75) a syringe, with a piece of tubing attached, that will fit snugly onto valve #29's input nozzle is required. **Read the procedure before continuing!**

a) Allow valve #29's dot to turn blue and then return to white.

b) QUICKLY CLAMP and remove the tubing from valve #29's nozzle.

c) QUICKLY attach the syringe tubing to the empty nozzle.

d) Watching screen 0, allow valve #29's dot to turn blue (**for ONLY 9 seconds at a time!**). If the valve is open you should be able to push through it with no resistance (three scenarios):

   1) **Can push through but with <u>significant</u> resistance:** Replace valve #29.

   2) **Cannot push through at all:** Four possibilities: 1) Bad actuator board; 2) Bad valve #29 and/or its blue wire harness; 3) Bad actuator cable; 4) Bad distribution board.

   3) **Can EASILY push through:** Reattach #29's tubing, remove the clamp then see procedure number CLEAN- 5.0.0 (page 76).

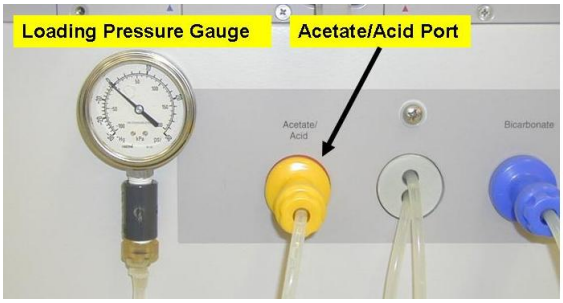
CLEAN- 5.0.0 CHECK FOR FLOW ERRORS IN DIALYSIS PROGRAM

a) Turn the machine off and then back on.

b) Connect to fresh concentrate and place the machine into Dialysis Program (remember to press the 'CONFIRM' key).

c) **IMPORTANT!** ASSURE Dialysate flow is ON (Dialysate Flow on/off LED off).

d) Assuring the loading pressure gauge (with yellow connector) reads 0 psi before inserting it, **SLAM** it into the Acetate/Acid port. If (and ONLY if) it does NOT peak to between: 23 and 27 psi (**equipped with DiaSafe® filter**); 17 and 23 psi (**NOT equipped with DiaSafe® filter**) proceed to **page 18**, procedure number **F- 2.0.4**.

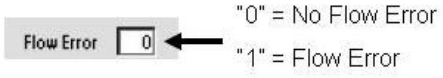


e) **IMPORTANT!** If Automated Tests start (screen reads "Test …") at ANY time allow them to complete! Automated Testing, while troubleshooting, may cause misdiagnosis! IGNORE all test fail messages for now!

f) Do NOT reset alarms until instructed!

g) Call the Home screen and set Dialysate Flow to 800 ml/min (NOT "a800").

h) Call debug screen 0. CAREFULLY watch **Flow Error** for three minutes. Proceed accordingly:



- **Flow Error = 1 (constant or intermittent):** Proceed to **page 14**, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM.
- **Flow Error = 0 (constant):** See procedure number CLEAN- 5.0.1 (page 76).

CLEAN- 5.0.1 CHECK TEMPERATURE / CONDUCTIVITY / TMP

a) Place a venous dummy chamber in the Level Detector.

b) RESET an Air Detector alarm i.e. the red alarm LED (see Figure right) turns off.

c) Allow five minutes. From the HOME screen (two checks):

1) **Temperature** MUST be between 35.5 and 38.5° C AND does not vary more than +/- 0.15° C.

2) **Conductivity** MUST be between 13.0 and 14.5 mS AND does not vary greater than +/- 0.2 mS.

d) ASSURE the Bypass LED (front panel) turns off and then allow 30 seconds.

e) Call debug screen 0 and ASSURE **Flow Error** remains = 0. There MUST be flow through the external flow indicator!

f) Press and release the 'RESET' key then immediately press and hold it for three seconds. **Ignore temporary Flow Errors during reset!** If the "Adjusting TMP" message is present allow it to expire. If a TMP alarm occurs attempt the RESET sequence up to twice more then continue.

g) Does a TMP alarm continue to occur?

Yes Proceed to **page 168**, TMP PROBLEMS.

No The machine remains free of TMP alarms. See procedure number CLEAN- 5.0.2 (page 77).

CLEAN- 5.0.2 CHECK VERR

a) Referring to the Figure (right), UNPLUG the air sensor's connector from distribution board position "AIR-SEN".

b) With the "AIR-SEN" position **empty**, allow 30 seconds.

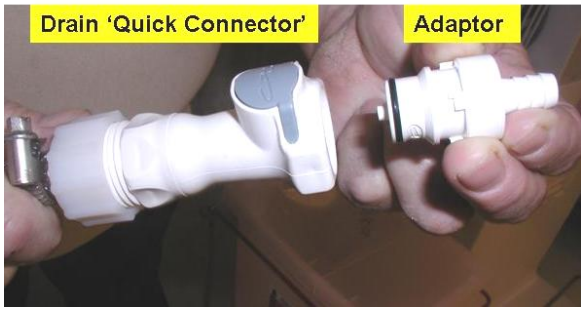
c) Call debug screen 1, ASSURE **FILACT** = 1 (indicating the air sensor is unplugged).

d) From debug screen 1, is **VERR** greater than 5?

Yes **NOTE** that **Valve #43** is causing a Valve Error and proceed to **page 84**, procedure number **VE- 2.0.0**.

No See procedure number CLEAN- 5.0.3 (page 77).

CLEAN- 5.0.3 CHECK VALVE #43 OPEN



a) Referring to the Figure (right), at the far end of the drain tubing, if a 'Quick Connector' is present, an **adaptor** IS required to allow flow through the connector. Another option is to remove the 'Quick Connector'.

b) **IMPORTANT!** ASSURE Dialysate flow is ON (Dialysate Flow on/off LED off).

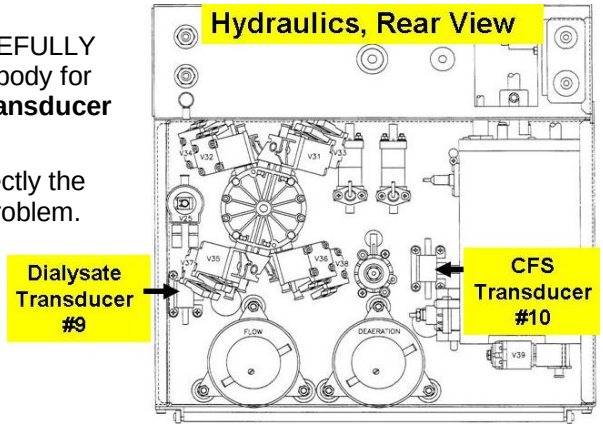
c) ACCURATELY measure drain flow for one minute into a 1000 ml graduated cylinder. 250 ml or greater?

Yes See procedure number CLEAN- 5.0.4 (page 77).

No a) Before continuing, ASSURE Dialysate flow is ON (Dialysate Flow on/off LED off)! If (and ONLY if) Flow is not ON repeat procedure number CLEAN- 5.0.3 (page 77) from part b.

b) Proceed to page 21, procedure number **F- 3.4.0**.

CLEAN- 5.0.4 CHECK TRANSDUCERS



a) Referring to the Figure (right), using a flashlight, CAREFULLY check the (blue) dialysate pressure transducer's (#9) body for external (rust colored) leakage. **Replace a leaking transducer as this may be the problem!**

b) Assuming all above procedures were performed correctly the Troubleshooting Guide cannot locate an immediate problem. If the problem continues:

- **BE VERY certain that the vent tubing is not restricted in any way!**
- If the problem is occurring in Heat Disinfect, after Pre-Rinse time has expired, and the external flow indicator's 'bob' is NOT rising there may be an intermittent loss of loading pressure or valve #29 is bad (i.e. "Flow Recirc Error 1" message).
- If the problem is occurring in Heat Disinfect and the external flow indicator's 'bob' IS continually rising and falling the dialysate pressure transducer (#9) may be intermittent bad ("Flow Recirc Error 1" message).
- If the problem is occurring in a program other than Heat Disinfect there may be an intermittent loss of loading pressure ("Flow Inlet Error" message), valve #43 sticking closed intermittent, or an intermittent hydraulic restriction.

TROUBLESHOOTING VALVES

A) **Proceed ONLY with the valve(s) as NOTED in the procedure that brought you here. THERE IS NO NEED TO CHECK ALL VALVES!**

B) These procedures troubleshoot valves that are not opening. Four possibilities: 1) Bad valve solenoid and/or its wiring harness; 2) Bad actuator board; 3) Bad actuator cable; 4) Bad distribution board.

C) See procedure number TSV- 1.0.0 (page 78).

TSV- 1.0.0 CHECK DISTRIBUTION BOARD CONNECTIONS

a) Referring to the Figure 34 (page 78) assure the **NOTED** valve(s) connector are plugged into their CORRECT distribution board position AND aligned properly.

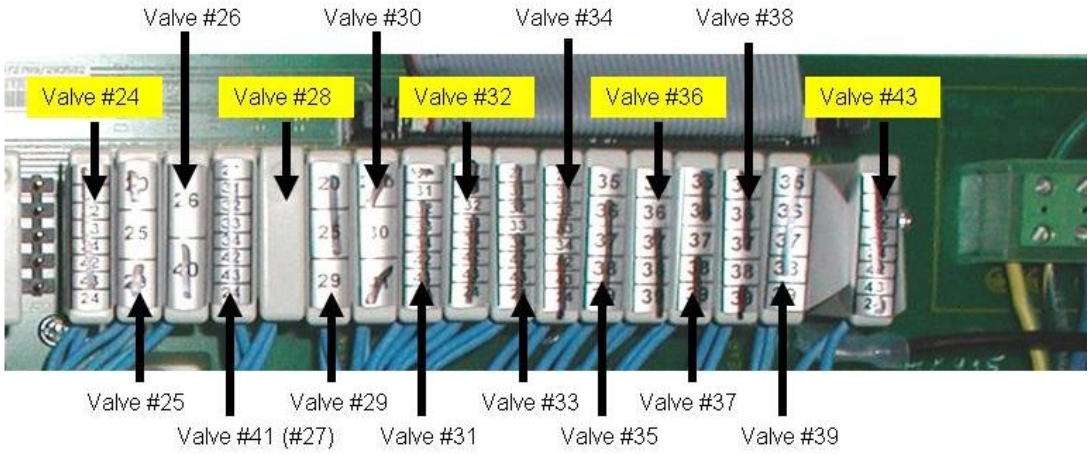


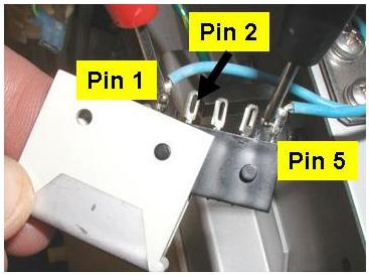
Figure 34 – Distribution Board

b) Referring to Figure 35 A (page 79) and/or Figure 35 B (page 79), trace the **NOTED** valve(s) blue two-wire harness from the distribution board and assure it (they) terminate at the correct valve.

c) ASSURE the wire harnesses are NOT pinched between the rear hydraulic cabinet and the UF or bicarbonate pump. CAREFULLY check the blue harness for damage (exposed or pinched wires, etc).

d) Referring to the Figure (right), check the (black) solenoid terminals for rust or corrosion.

e) Unplug the **NOTED** valve(s) from the distribution board. Using a flashlight, check **inside** the vacant position for 'white' corrosion or damaged **male** pins. There should be five pins.



f) Referring to the Figure (right), remove the cap from the female distribution board connector. ASSURE good solder connections. NOTE: All valves EXCEPT #26 should be wired between ***pins 1* and *5*** (top and bottom). Valve #26 (ONLY) should be wired between ***pins 2* and *5*** (second from the top and bottom).

g) Measure solenoid resistance, inside the female connector, between the terminals, where the blue wires are soldered. Between 40 and 100 **Ω**?

Yes See procedure number TSV- 3.0.0 (page 80).

No See procedure number TSV- 2.0.0 (page 79).

NOTE! Valves #24 and #26 locations depend on the <u>On Line Clearance</u> (OLC) option. Valve #30's location depends on the <u>Aliquot</u> option (see Figure 35 B, page 79).

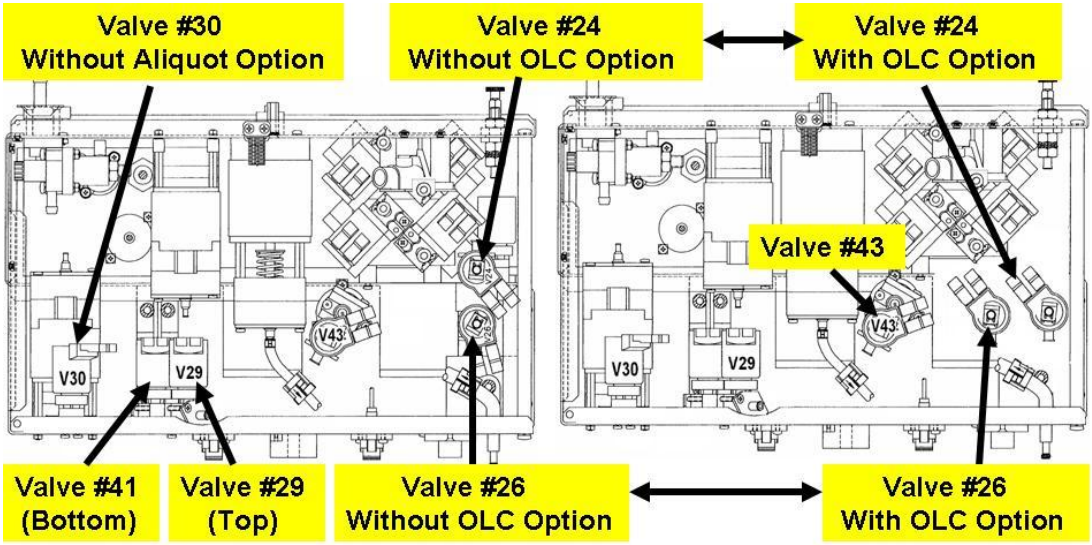


Figure 35 A – Valve Locations (Hydraulics, Top View)

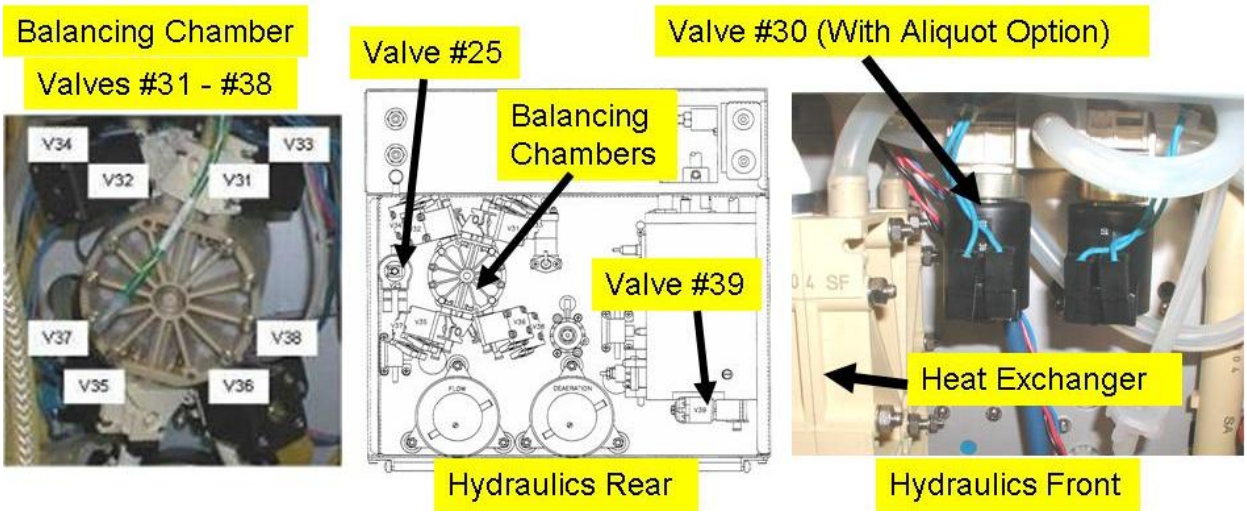


Figure 35 B – Valve Locations (Hydraulics Rear and Front View)

<u>TSV- 2.0.0 CHECK SOLENOID</u>

a) Referring to Figure 35 A (page 79) and/or Figure 35 B (page 79), locate the **<u>NOTED</u>** valve(s).

b) Referring to the Figure (right), measure resistance (Ω) between the metal solenoid terminals. Between 40 and 100 **<u>Ω</u>**?

Yes	The two-wire (blue) valve wiring harness is bad.
No	Replace the valve.

TSV- 3.0.0 OLD OR NEW STYLE ACTUATOR BOARD

a) **IMPORTANT!** Turn the machine off!

b) Open the card cage. Referring to Figure 36 (page 80), the **old-style** actuator board has large black heat sinks that run vertically along the rear and front edge of the board and its integrated circuits are mounted in sockets. The **new-style** actuator/test board does not have heat sinks and its integrated circuits are surface mounted.

c) Is the machine equipped with the **old** or **new-style** actuator board?

Old-Style: Two possibilities: 1) Bad actuator board (see Figure 4A, page 8); 2) Bad NOTED valve(s).

New-Style: Four possibilities: 1) Bad actuator board; 2) Bad actuator cable [a]; 3) Bad distribution board; 4) BAD NOTED valve(s)

[a] The cable can be checked for continuity. Proceed to page 225, SECTION 16 - CHECKING THE ACTUATOR BOARD CABLE

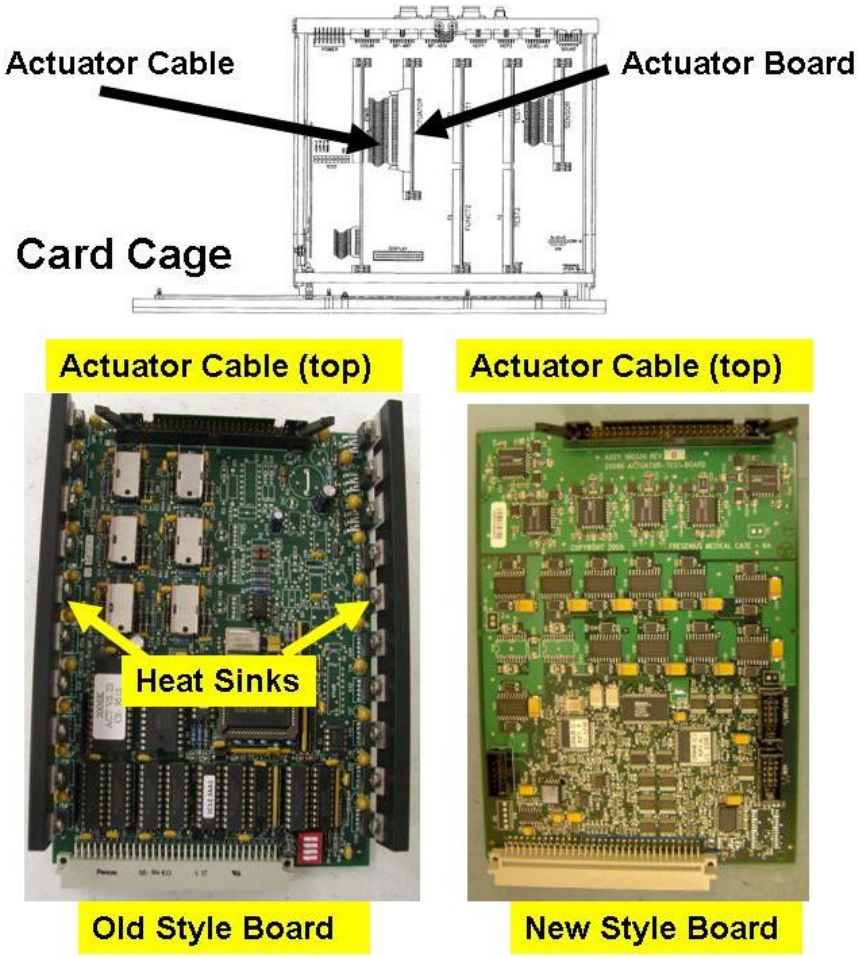


Figure 36 – Actuator Board (Old Style, New Style)

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TROUBLESHOOTING VALVE ERRORS

A valve's 'solenoid circuit' is in a high or low resistance state causing a digital counter called **VERR** (debug screen 1) to increase at one unit per second up to its maximum of 255.

a) **IMPORTANT!** If not already done perform INITIAL CHECKS (page 6).

b) The procedure that brought you here asked you to **NOTE** which program (**DIALYSIS** or **RINSE** or **HEAT DISINFECT**) the valve error is occurring in. Proceed accordingly:

- **DIALYSIS:** With the machine in Dialysis program and Dialysate flow ON (Dialysate Flow on/off LED off), see procedure number VE- 1.0.0 (page 81).
- **RINSE:** **NOTE** that **three** valves will be checked (#29 AND #39 AND #43) then see procedure number VE- 2.0.0 (page 84).
- **HEAT DISINFECT:** **NOTE** that **three** valves will be checked (#29 AND #39 AND #43) then see procedure number VE- 2.0.0 (page 84).

VE- 1.0.0 VALVE ERROR IN DIALYSIS PROGRAM

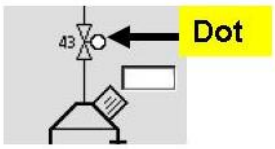
a) Close the shunt door!

b) **IMPORTANT!** Do NOT reset alarms as this may mask or alter symptoms.

c) Call debug screen 0 and watch for one minute. Referring to Figure 37 (page 82), **CAREFULLY** consider each of the six scenarios described below and proceed accordingly:

1. If (and ONLY if) a "No Water" message is present **NOTE** that **VALVE #41** will be checked and that it plugs into distribution board position #27. See procedure number VE- 2.0.0 (page 84).

2. If (and ONLY if) Valve #43's dot = blue (constantly or intermittently) **NOTE** that **VALVE #43** will be checked then see procedure number VE- 1.0.1 (page 82).



3. If (and ONLY if) Valve #43's dot is REMAINING white AND **Balancing Chamber Valve's #35, #38, #32, and #33** dots are REMAINING blue. **Valve cycle ONE Valve Error!** See procedure number VE- 1.3.3 (page 83).

4. IF(and ONLY if) Valve #43's dot is REMAINING white AND **Balancing Chamber Valve's #31, #34, #36, and #37** are REMAINING blue. **Valve cycle Two Valve Error!** See procedure number VE- 1.4.3 (page 83).

5. If (and ONLY if) Valve #43's dot is REMAINING white AND the **Balancing Chamber Valve's (#31 through #38)** dots are cycling white – blue – white – etc. See procedure number VE- 1.0.2 (page 82).

6. If (and ONLY if) **ALL EIGHT** balancing chamber valve's (#31 - #38) dots are REMAINING white, open the shunt door (to close valve #25) and wait 30 seconds. Do the balancing chamber valve's dots to cycle white – blue – white – etc?

   Yes **NOTE** that valve #25 will be checked then see procedure number VE- 2.0.0 (page 84).

   No **NOTE** that valve #30 AND valve #26 will be checked then see procedure number VE- 2.0.0 (page 84).

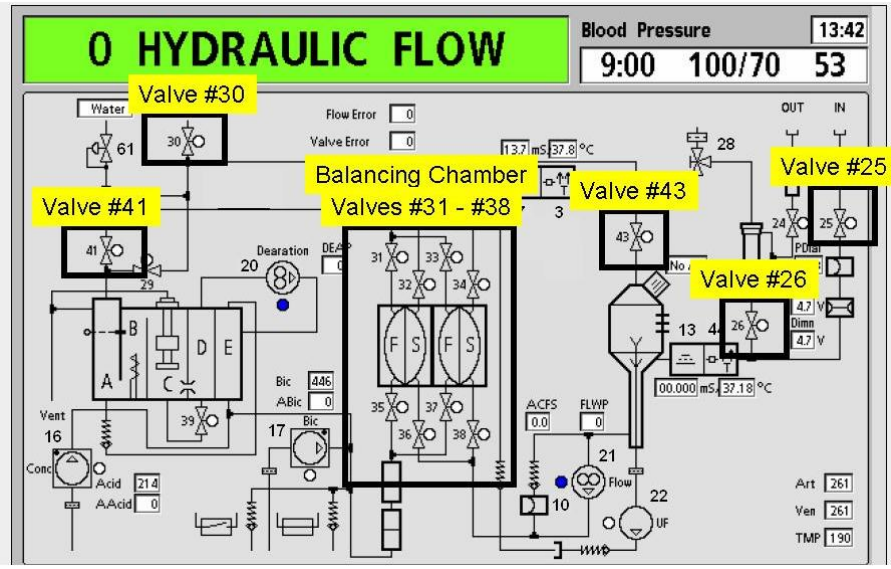


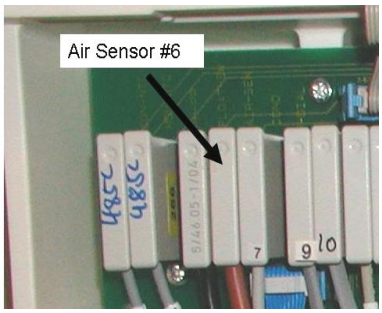
Figure 37 – Debug Screen 0

VE- 1.0.1 CHECK FOR VALVE ERROR AT VALVE #43

a) Call debug screen 1. Watch **VERR** for one minute (if necessary) to assure its still increasing. If (and ONLY if) VERR is not increasing return to **page 15**, procedure number **F- 1.0.3**.

b) Turn the machine off.

c) Referring to the Figure (right), plug one of the resistor plugs, from the four-resistor Temperature set, into the air sensor's distribution board position labeled "AIR-SEN" (**4th connector**, **5th position from the left**).



d) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

e) Allow 30 seconds. From screen 1, if the resistor plug is placed properly, **FILACT** = 0 constantly.

f) From screen 1, does **VERR** stop increasing?

Yes **NOTE** that valve #43 will be checked then see procedure number VE- 2.0.0 (page 84).

No See procedure number VE 1.0.2 (page 82).

VE- 1.0.2 POSSIBLE VALVE ERROR AT VALVE #43

a) Referring to the Figure (above, right), unplug the air sensor's connector (or resistor plug, if placed previously) from distribution board position labeled "AIR-SEN".

b) Allow 30 seconds. From debug screen 1, if the air sensor was unplugged, **FILACT** should = 1 constant.

c) Watch **VERR** for one minute. Is it increasing at one unit per second?

Yes **NOTE** that valve #43 (ONLY) will be checked then see procedure number VE- 2.0.0 (page 84)

No Return to **page 17**, procedure number **F- 2.0.0**.

VE- 1.3.3 VALVE ERROR AT BALANCING CHAMBER VALVE CYCLE ONE

a) Turn the machine off and then back on.

b) Proceed accordingly depending on if working with a **K** or **K^2** or **K@HOME** machine:

- **K machine:** Press the screens 'Dialysis' button to call the 'CONFIRM Concentrate' screen but **do NOT 'CONFIRM' the Concentrate!** See part c.
- **K^2 machine:** Select the screen's 'Dialysis' button (it turns blue). Press the 'CONFIRM' key to call the 'CONFIRM Concentrate' screen but **do NOT 'CONFIRM' the concentrate!** See part c
- **K@HOME:** **NOTE** that valves #32 AND #33 AND #35 AND #38 will be checked then see procedure number VE- 2.0.0 (page 84).

c) Call debug screen 0. **IMPORTANT!** ASSURE the top balancing chamber valves (#31 through #34) are remaining blue and the bottom valves (#35 through #38) are remaining white. This is 'No Program'.

d) Call debug screen 1. Is **VERR** increasing at one unit per second?

Yes **NOTE** that valves #32 AND #33 will be checked then see procedure number VE- 2.0.0 (page 84).

No **NOTE** that valves #35 AND #38 will be checked then see procedure number VE- 2.0.0 (page 84).

VE- 1.4.3 VALVE ERROR AT BALANCING CHAMBER VALVE CYCLE TWO

a) Turn the machine off and then back on.

b) Proceed accordingly depending on if working with a **K** or **K^2** or **K@HOME** machine:

- **K machine:** Press the screens 'Dialysis' button to call the 'CONFIRM Concentrate' screen but **do NOT 'CONFIRM' the Concentrate!** See part c.
- **K^2 machine:** Select the screen's 'Dialysis' button (it turns blue). Press the 'CONFIRM' key to call the 'CONFIRM Concentrate' screen but **do NOT 'CONFIRM' the concentrate!** See part c.
- **K@HOME:** **NOTE** that valves #31 AND #34 AND #36 AND #37 will be checked then see procedure number VE- 2.0.0 (page 84).

c) Call debug screen 0. **IMPORTANT!** ASSURE the top balancing chamber valves (#31 through #34) are remaining blue and the bottom valves (#35 through #38) are remaining white.

c) Call debug screen 1. Is **VERR** increasing at one unit per second?

Yes **NOTE** that valves #31 AND #34 will be checked then see procedure number VE- 2.0.0 (page 84).

No **NOTE** that valves #36 AND #37 will be checked then see procedure number VE- 2.0.0 (page 84).

VE- 2.0.0 CHECK SOLENOID CIRCUIT(S)

As NOTED previously, in some cases, more than one valve may need to be checked! ONLY the NOTED valve(s) needs to be checked!

a) Referring to Figure 38 (page 84), assure the **NOTED** valve(s) are plugged into the distribution board at their correct location AND the connectors are aligned properly. **If not, this is the problem!**

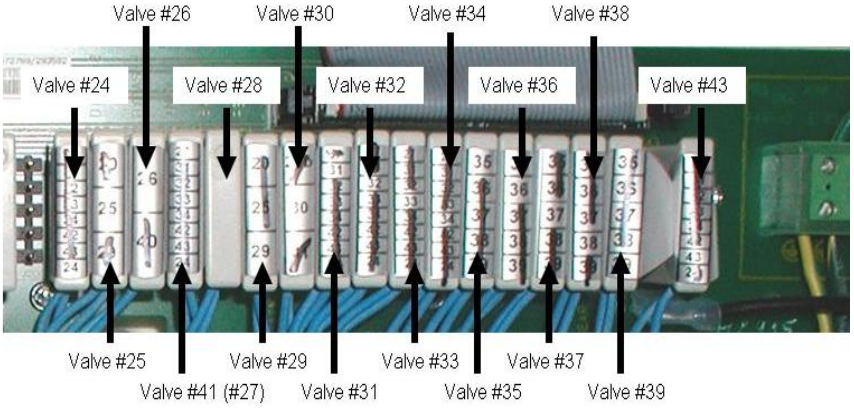
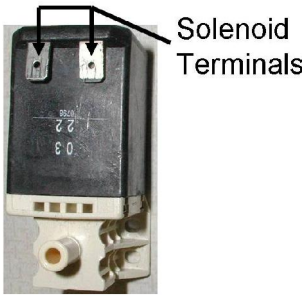
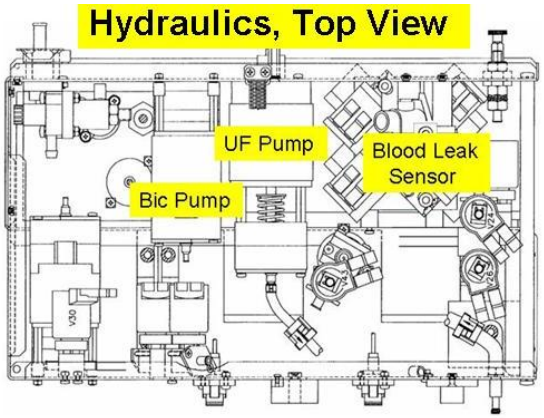


Figure 38 – Distribution Board



b) Referring to Figure 39 (page 85) or Figure 40 (page 85) trace the **NOTED** valve(s) blue two-wire harnesses from the distribution board to the valve's (black) solenoid. **If a harness is not plugged into the solenoid terminals (see Figure right) this is the problem!**

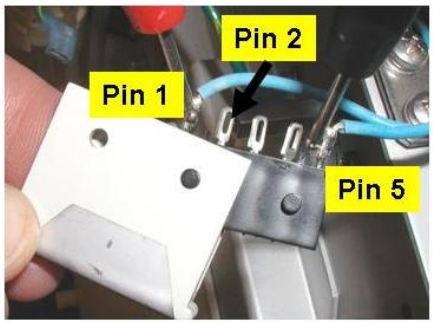
c) **IMPORTANT!** Referring to the Figure (below, right), ASSURE the **NOTED** valve(s) blue wiring harnesses are not pinched between the rear panel and the UF pump, bicarbonate (Bic) pump or the blood leak sensor. **If pinched, this may be the problem!**



d) CAREFULLY check each **NOTED** valve(s) blue harness for damage (exposed wires, pinched, etc). **If damage is located this may be the problem!**

e) Check each **NOTED** valve(s) the solenoid(s) and terminals for rust or corrosion. **If rust is located this may be the problem!**

f) Referring to the Figure (below, right), remove the cap from each NOTED valve's female distribution board connector. **All valves, with the EXCEPTION of valve #26, should be soldered between pins 1 and 5 (top and bottom). Valve #26 should be soldered between *pins 2* and 5 (second from top and bottom)!**



g) Measure resistance (Ω) between the terminals, of all **NOTED** valves, where the blue wires are soldered. Is the meter's numeric AND units display indicating between 40 and 100 **Ω**?

Yes See procedure number VE- 2.0.1 (page 85).

No The valve's solenoid or its blue wiring harness is bad. **Replace BOTH!**

NOTE! Valves #24 and #26 locations depend on the <u>On Line Clearance</u> (OLC) option. Valve #30's location depends on the <u>Aliquot</u> option (see Figure 40, page 85).

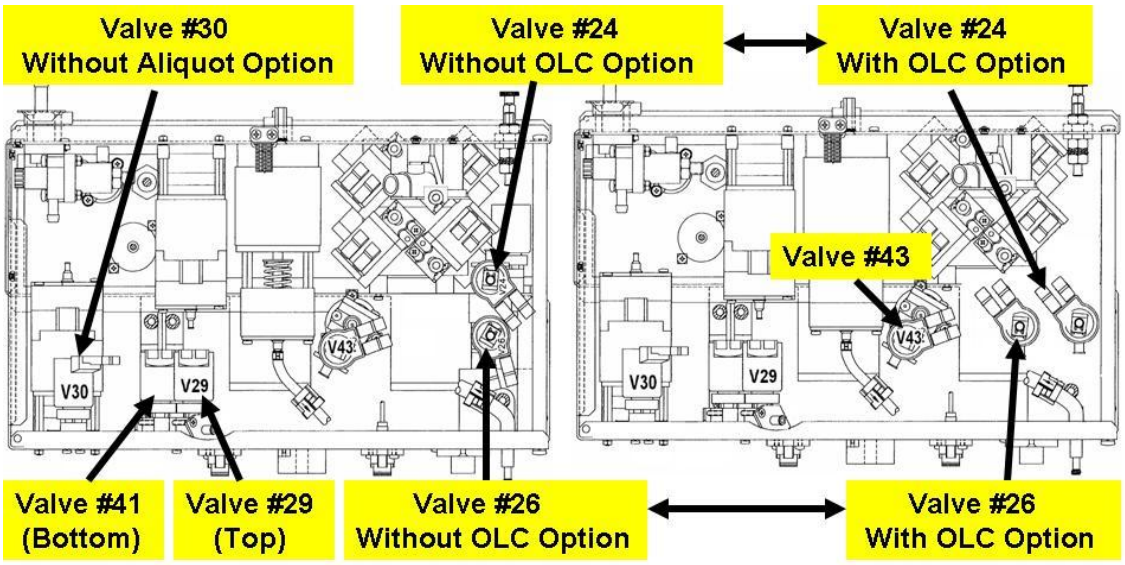


Figure 39 – Hydraulics (Top View)

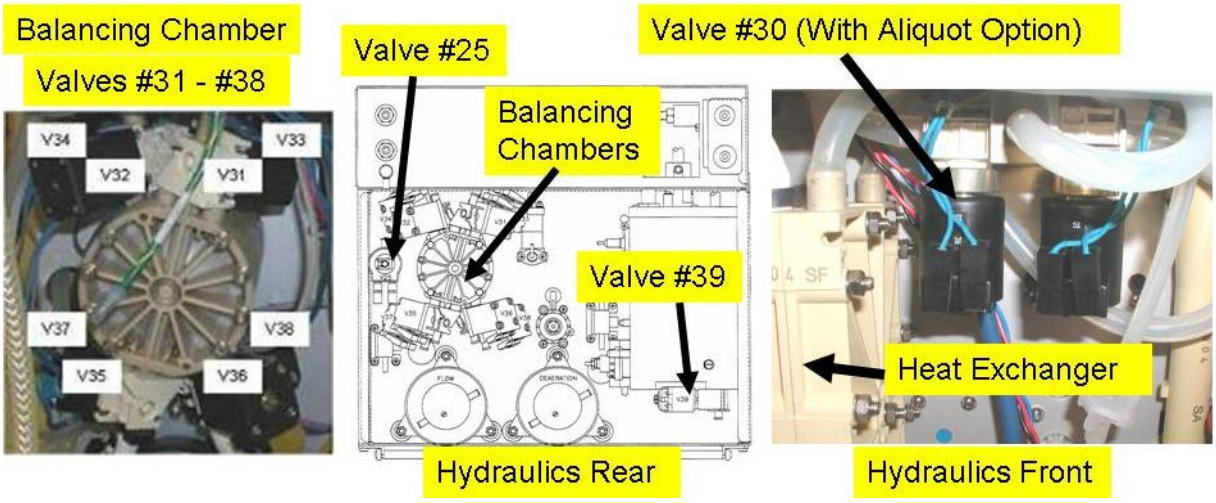


Figure 40 – Hydraulics (Rear / Front View)

<u>VE- 2.0.1 RECHECK VALVE CIRCUIT</u>

a) Using a flashlight, CAREFULLY check **<u>inside</u>** the vacant distribution board position(s) of all **<u>NOTED</u>** valve(s), for 'white' corrosion or damaged **<u>male</u>** pins. There should be five pins. If corrosion or damage is located the distribution board may have to be replaced.

b) Referring to Figure 38 (page 84) CAREFULLY return the **<u>NOTED</u>** valve(s) connector(s) to their **CORRECT** distribution board position(s). **CAUTION! There are several unused positions! Avoid them!**

c) Assure the connector(s) plug in smoothly otherwise the distribution board pins may be bent or corroded.

d) As **<u>NOTED</u>** previously, is the Valve Error occurring in **Rinse** or **Heat Disinfect** or **Dialysis** program?

- **Rinse or Heat Disinfect:** See procedure number VE- 2.0.2 (page 86).
- **Dialysis:** See procedure number VE- 2.0.3 (page 86).

VE- 2.0.2 CHECK VALVE ERROR IN RINSE

a) Place the machine into Rinse Program and allow four minutes.

b) Call debug screen 1. Is **VERR** greater than 5?

Yes Assuming that all above procedures were performed correctly, three possibilities: 1) Bad actuator board; 2) Bad actuator cable; 3) Bad distribution board. **To isolate between the three see procedure number VE- 3.0.0 (page 86)**.

No Reseating the connectors may have remedied the Valve Error.

VE- 2.0.3 CHECK VALVE ERROR IN RINSE

a) Place the machine into Dialysis Program (remember to press the 'CONFIRM' key).

b) **IMPORTANT!** Allow 30 seconds then call debug screen 1. Is **VERR** greater than 5?

Yes Assuming all above procedures were performed correctly, three possibilities: 1) Bad actuator board; 2) Bad actuator cable; 3) Bad distribution board. **To isolate between the three see procedure number VE- 3.0.0 (page 86)**.

No Reseating valve connectors may have remedied the Valve Error.

VE- 3.0.0 TROUBLESHOOTING VALVE ERRORS

These procedures check solenoid resistance (Ω) from the actuator board, through the actuator cable, distribution board, and the valve's blue wiring harness:

- **Check ALL NOTED valves**
- **CAREFULLY read the meter's numeric AND units display (MΩ = Million ohms; KΩ = Thousand ohms; "OL" = resistance too big to read)**

a) **IMPORTANT!** Turn the machine off!

b) Open the card cage and place a meter lead at chassis ground (see Figure 1, page 3).

c) Referring to Figure 41 (page 86), at the top of the actuator board is a large connector (P2). The solder (rear) side is arranged in two rows. Odd numbered pins (1, 3, etc) in the bottom row; even numbered (2, 4, etc) in the top. As instructed **later** solenoid resistance(s) **will be** measured from these pins. There is **NO NEED** to check all pins! **ONLY** the **NOTED** valves per Table 5 (page 87).

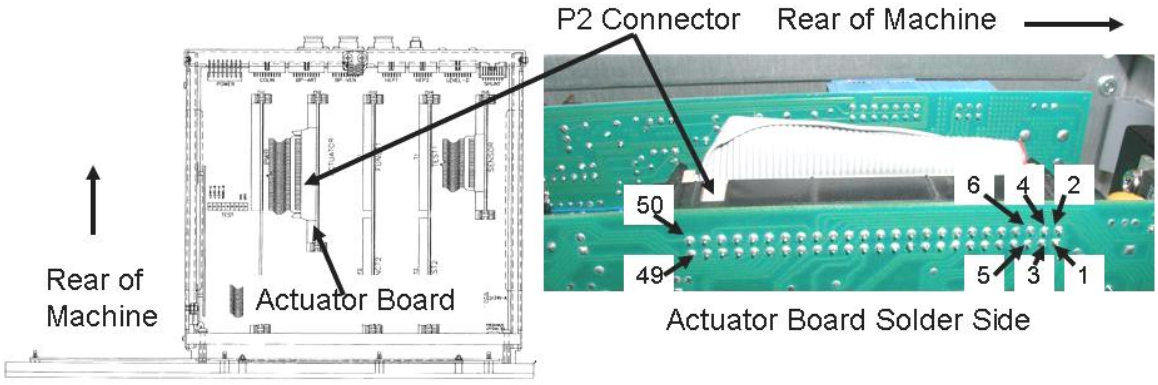


Figure 41 – Electronic Card Cage

Table 5 – Noted Valve Checks

To check valve #43	See Table 8 (page 88)	**To check valves #35 and #38**	See Table 9 (page 88)
To check valves #39, #29 and #43	See Table 14 (page 91)	**To check valves #36 and #37**	See Table 11 (page 89)
To check valves #30 and #26	See Table 13 (page 90)	**To check valve #25**	See Table 12 (page 90)
To check valves #31 and #34	See Table 10 (page 89)	**To check valve #41 (#27)**	See Table 6 (page 87)
To check valves #32 and #33	See Table 7 (page 87)		

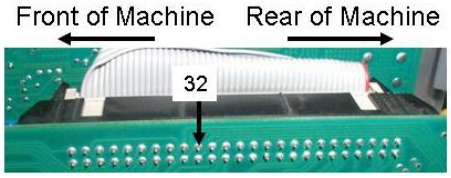


Table 6 (Valve #41, #27)

VALVE#	PIN#	P2 LOCATION	Resistance Reading (see column below)
41	32	**Top** row, 10 pins from the **front** of the machine	• **Between 40 AND 100 Ω:** Bad actuator board. • **Less than 39 Ω:** Bad actuator board • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator cable; 2) Bad distribution board

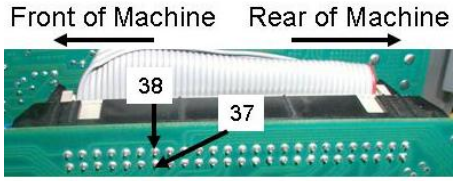


Table 7 (Valves #32 and #33)

VALVE#	PIN#	P2 LOCATION	Resistance Reading (see column below):
32	37	**Bottom** row, 7 pins from the **front** of machine	• **Between 40 AND 100 Ω:** Check valve #33 (**pin #38**, next row in this table). • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator board; 2) Bad distribution board
33	38	**Top** row, 7 pins from the **front** of the machine	• **Between 40 Ω AND 100 Ω**: If BOTH valves are between 40 and 100 Ω the actuator board is bad • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator cable; 2) Bad distribution board

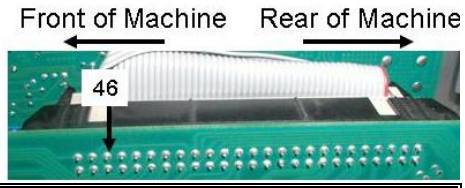


Table 8 (Valve #43)

VALVE#	PIN#	P2 PIN LOCATION	Resistance Reading (see column below):
43	46	**Top** row, 3 pins from the **front** of the machine	• **Between 40 AND 100 Ω:** Bad actuator board. • **Less than 39 Ω:** Bad actuator board • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator cable; 2) Bad distribution board

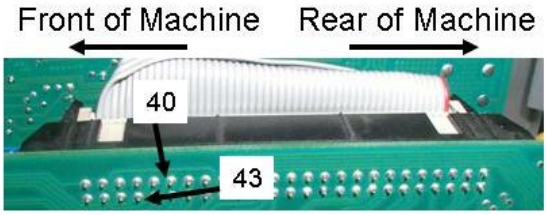


Table 9 (Valves #35 and #38)

VALVE#	PIN#	P2 LOCATION	Resistance Reading (see column below):
35	40	**Top** row, 6 pins from the **front** of the machine	• **Between 40 AND 100 Ω:** Check valve #38 (**pin #43**, next row in this table). • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator board; 2) Bad distribution board
38	43	**Bottom** row, 4 pins from the **front** of the machine	• **Between 40 Ω AND 100 Ω**: If BOTH valves are between 40 and 100 Ω the actuator board is bad • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator cable; 2) Bad distribution board

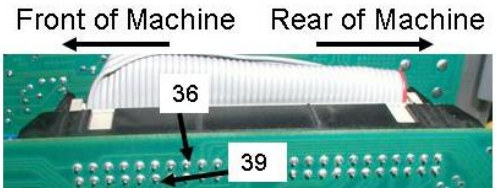


Table 10 (Valves #31 and #34)

VALVE#	PIN#	P2 LOCATION	Resistance Reading (see column below):
31	36	**Top** row, 8 pins from the **front** of the machine	• **Between 40 AND 100 Ω:** Check valve #34 (**pin #39**, next row in this table). • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator board; 2) Bad distribution board
34	39	**Bottom** row, 6 pins from the **front** of the machine	• **Between 40 Ω AND 100 Ω**: If BOTH valves are between 40 and 100 Ω the actuator board is bad • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator cable; 2) Bad distribution board

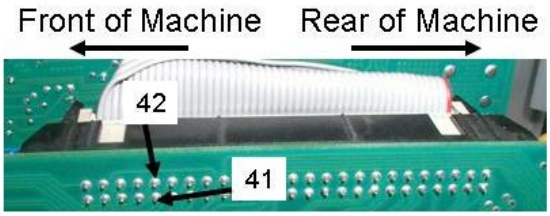


Table 11 (Valves #36 and #37)

VALVE#	PIN#	P2 LOCATION	Resistance Reading (see column below):
36	41	**Bottom** row, 5 pins from the **front** of machine	• **Between 40 AND 100 Ω:** Check valve #37 (**pin #42**, next row in this table). • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator board; 2) Bad distribution board
37	42	**Top** row, 5 pins from the **front** of machine	• **Between 40 Ω AND 100 Ω**: If BOTH valves are between 40 and 100 Ω the actuator board is bad • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator cable; 2) Bad distribution board

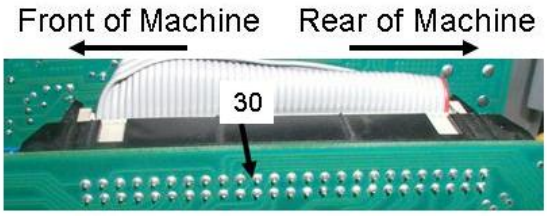


Table 12 (Valve #25)

VALVE#	PIN#	P2 LOCATION	Resistance Reading (see column below)
25	30	**Top** row, 11 pins from the **front** of the machine	• **Between 40 AND 100 Ω:** Bad actuator board. • **Less than 39 Ω:** Bad actuator board • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator cable; 2) Bad distribution board

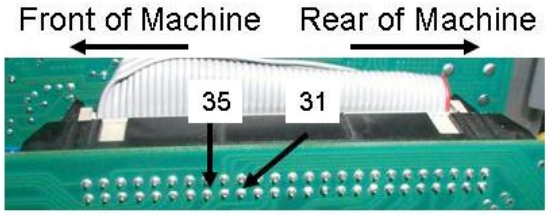


Table 13 (Valves #30 and #26)

VALVE#	PIN#	P2 LOCATION	Resistance Reading (see column below):
30	35	**Bottom** row, 8 pins from the **front** of the machine	• **Between 40 AND 100 Ω:** Check valve #26 (**pin #31**, next row in this table). • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator board; 2) Bad distribution board
26	31	**Bottom** row, 10 pins from the **front** of the machine	• **Between 40 Ω AND 100 Ω**: If BOTH valves are between 40 and 100 Ω the actuator board is bad • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator cable; 2) Bad distribution board

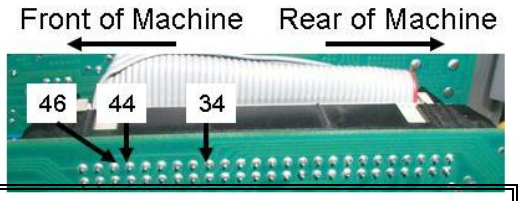


Table 14 (Valves #39, #29 and #43)

VALVE#	PIN#	P2 PIN LOCATION	Resistance Reading (see column below):
39	44	**Top** row, 4 pins from the **front** of the machine	• **Between 40 AND 100 Ω:** Check valve #29 (**pin #34**, next row in this table). • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator board; 2) Bad distribution board
29	34	**Top** row, 9 pins from the **front** of the machine	• **Between 40 AND 100 Ω:** Check valve #43 (**pin #46,** next row in this table). • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator board; 2) Bad distribution board
43	46	**Top** row, 3 pins from the **front** of the machine	• **Between 40 Ω AND 100 Ω**: If ALL THREE valves are between 40 and 100 Ω the actuator board is bad • **Less than 39 Ω:** Bad actuator board. • **Greater than 101 Ω:** Two possibilities: 1) Bad actuator cable; 2) Bad distribution board

SECTION 4 - TEMPERATURE PROBLEMS

These procedures troubleshoot Temperature problems and check stability factors that may cause On-Line Clearance (OLC) problems.

A) If (and ONLY if) a "No Water" message appears at **ANY TIME** proceed to page 64, SECTION 2 - NO WATER.

B) **Temperature changes are NOT instantaneous so be patient. Observe ALL stated times to avoid error and/of potential damage to the machine!**

C) Is the problem occurring in **Dialysis** or **Heat Disinfect** program (proceed accordingly)?

- ***Dialysis:***

  a) ASSURE the machine has been running, with Dialysate flow ON (Dialysate Flow on/off LED off), connected to fresh concentrate, for at least five minutes!

  b) **IMPORTANT!** If Automated Tests start (screen reads "Test …") allow them to complete! Automated Testing, while troubleshooting, may cause misdiagnosis! IGNORE all test fail messages for now!

  c) Remove the venous 'dummy chamber' from the Level Detector to prevent "Forced Test".

  d) From the Home screen, after CAREFULLY observing **Temperature** for five minutes, **eight minutes** if it is unstable (i.e. varies greater than +/- 0.15° C per minute). Three scenarios:

  1) **Unstable AND exceeds 41° C at some point:** See procedure number T- 1.0.5 (page 94).

  2) **Remains less than 35.5°C:** See procedure number T- 1.0.0 (page 93).

  3) **All other symptoms (NEVER exceeds 41° C):** See procedure number T- 1.0.1 (page 93).

- ***Heat Disinfect*:** From the Heat Disinfect screen, watch for three minutes. Is a Flow Error related message occurring?

  Yes Proceed to **page 70**, SECTION 3 – FLOW ERRORS IN CLEANING / DISINFECTION PROGRAMS.

  No Proceed accordingly (four scenarios):

  1) **Exceeds 91° C at some point:** See procedure number T- 1.0.5 (page 94).

  2) **"TEMP OVER 95 DEGREES" message:** Turn the machine off then see procedure number T- 1.0.5 (page 94).

  3) **After five minutes, Temperature remains less than 35° C:** At the rear of the machine, on the power supply, is the HEATER switch pressed into "1" or ON"?

     Yes a) Connect to concentrate and place the machine into Dialysis Program (remember to press the 'CONFIRM' key)

     b) **IMPORTANT!** Allow five minutes then see procedure number T- 1.0.1 (page 93).

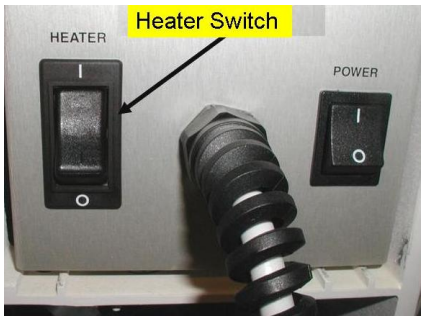
     No **This is the problem!** Press the rocker switch to "1" or "ON".

  4) **After thirty minutes, Temperature is greater than 35° C but fails to reach 80° C:**

     a) Connect to concentrate and place the machine into Dialysis Program (remember to press the 'CONFIRM' key).

     b) **IMPORTANT!** Allow five minutes then see procedure number T- 1.0.0 (page 93).

T- 1.0.0 CHECK HEATER SWITCH



Referring to the Figure (right), is the HEATER switch ON (rocker switch pressed into "1" or ON")?

Yes See procedure number T- 1.0.1 (page 93).

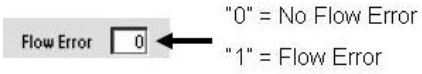
No **This is the problem!** Press the rocker switch to "1" or "ON".

T- 1.0.1 CHECK 'IN BYPASS' FLOW ERROR

a) **IMPORTANT!** Open the shunt door and leave it open until instructed otherwise.

b) From the Home screen set Dialysate flow to 800 ml/min (NOT "a800").

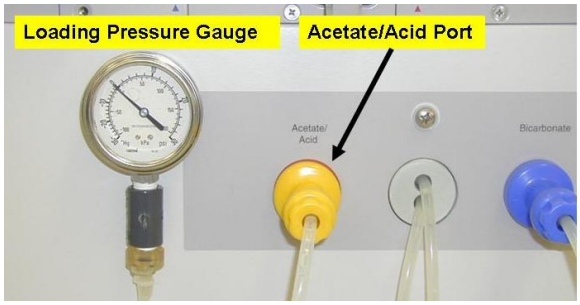
c) Call debug screen 0 to watch **Flow Error** for two minutes or until if **Flow Error** = 1. Proceed accordingly:



- **Flow Error = 1:** Proceed to page 14, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM.
- **Flow Error = 0:** See procedure number T- 1.0.2 (page 177).

Do NOT continue to troubleshoot Temperature problems if a Flow Error is or becomes present.

T- 1.0.2 CHECK LOADING PRESSURE



a) Assuring the loading pressure gauge (yellow connector) reads 0 psi before inserting it **SLAM** it into the red Acetate/Acid rinse port.

b) Per Table 15 (page 93), loading pressure MUST be **fluctuating** to its maximum **AND** NEVER dropping below its minimum. CAREFULLY watch BOTH levels for two minutes.

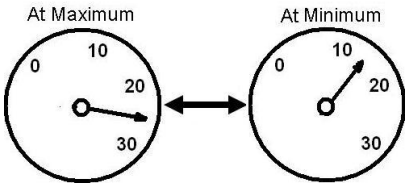
c) Is loading pressure 'okay'?

Yes Close the shunt door then see procedure number T- 1.0.3 (page 93).

No Close the shunt door then proceed to **page 18**, procedure number **F- 2.0.4**.

Table 15 – Loading Pressure

DiaSafe® filter?	Maximum:	Minimum (no lower than):
Yes	23 – 25 psi	16 psi
No	18 – 20 psi	11 psi



T- 1.0.3 SET TEMPERATURE

From the Home screen, select the screen's Temperature window. It turns bright yellow and displays the "Temp. Setting". Is Temperature set to 37° C?

Yes Press the 'CONFIRM' key then see procedure number T- 1.0.4 (page 94).

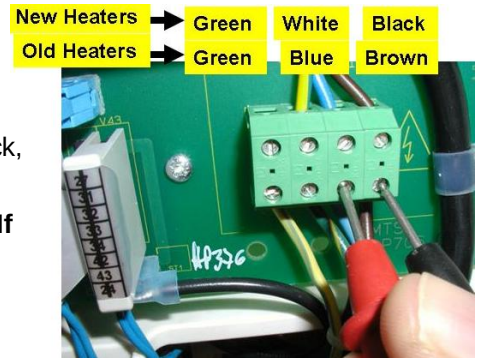
No a) Set Temperature to 37° C and press the 'Confirm' key. This establishes the alarm limits at 39 and 35° C.

b) Allow five minutes. If (and ONLY if) the Temperature problem is still present see procedure number T- 1.0.4 (page 94)

T- 1.0.4 CHECK HEATER WIRING / RESISTANCE

a) **IMPORTANT!** Turn the machine **OFF**! **CAUTION! Electrocution hazard if the machine is not off!**

b) Referring to the Figure (right), at the distribution board's heater connector (two checks):



1. Right to left, BOTTOM wire colors should be: **Old style heaters:** Brown, Blue, and Green; **New style heaters:** Black, White and Green.
2. 'Yank' on all six wires to assure they are securely attached. **If the connector or wires show damage this may be the problem!**

c) Touch the ohm meter leads together and subtract the resistance (Ω) reading from ALL subsequent resistance readings!

d) Measure resistance between the: **Old style heaters:** BLUE and BROWN wires; **New style heaters:** BLACK and WHITE wires. Is the meter's numeric AND units display indicating between 10 and 12.5 **Ω**?

Yes See procedure number T- 1.0.5 (page 94).

No Replace the heater (see Figure 6, page 13).

T- 1.0.5 CHECK TEMPERATURE SENSORS (NTC)

a) Referring to Figure 42 (page 94), **CAREFULLY** trace the cables from each NTC distribution board connector to their individual hydraulic locations. Two checks:

1) Assure all NTC's are connected correctly. If not, **this may be the problem!**

2) Replace the NTC if the insulation is damaged or is extremely 'sticky' as **this may be the problem!**

b) See procedure number T- 1.0.6 (page 95).

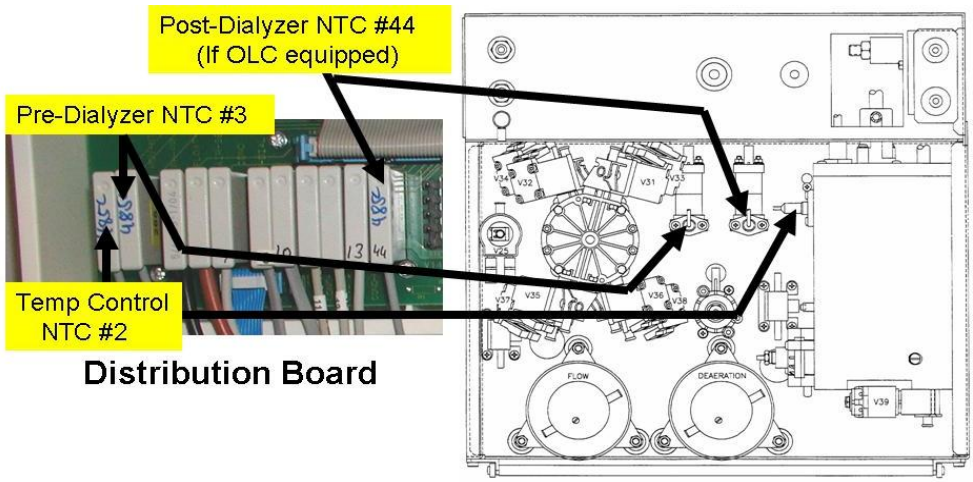


Figure 42 – Distribution Board / Rear Hydraulic View

NOTE: If Temperature is or was 'bouncing wildly' up and down, within 0.5 seconds, but does NEVER exceeds 41° (in Dialysis Program), 91° (in Heat Disinfect) this may indicate a torn balancing chamber diaphragm.

T- 1.0.6 CHECK FOR OPTIONAL BLOOD TEMPERATURE MODULE (BTM)

Referring to Figure 43 (page 95) is the machine equipped with the optional BTM?

Yes See procedure number T- 1.0.7 (page 95).

No See procedure number T- 1.0.8 (page 96).

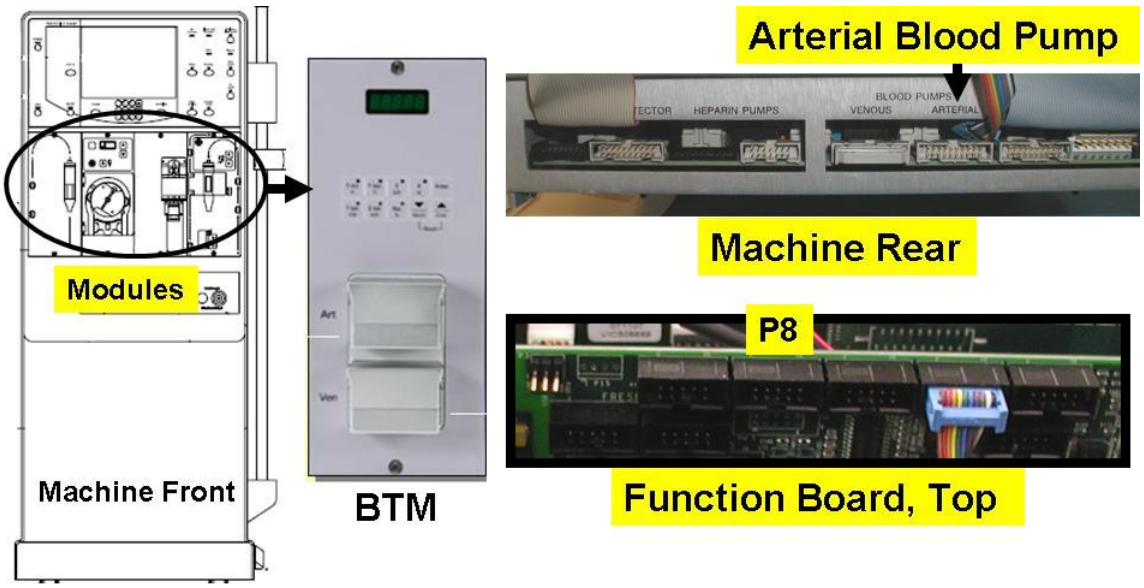


Figure 43 – Blood Temperature Module (BTM)

T- 1.0.7 ISOLATE THE BTM

a) Enter Service Mode → Options → Hardware Options. Set 'BTM' to "No" then press the 'CONFIRM' key (the "x" turns blue). **Post a note as a reminder that BTM is off!**

b) **IMPORTANT!** Turn the machine off.

c) Referring to Figure 43 (page 95) disconnect the BTM's:

- 20 pin ribbon cable from the arterial blood pump's connector (behind the machine)
- 10 pin ribbon cable at the function board's P8 connector (inside the electronic card cage)

d) Depending on where the problem was observed (i.e. **Dialysis** or **Heat Disinfect**), proceed accordingly:

- **Dialysis:** Return to Dialysis program (remember to press the 'CONFIRM' key). From the Home screen, **CAREFULLY** watch Temperature for **five minutes, ten minutes** if it is unstable! Is the problem still present?

  Yes Proceed accordingly (two scenarios):

  1. **Very unstable and exceeds 41° C at some point:** See procedure number T- 1.3.0 (page 100).
  2. **NEVER exceeds 41° C:** See procedure number T- 1.0.9 (page 96).

  No The BTM may be bad. Check its dip switch settings per its Operator's manual.

- **Heat Disinfect:** Return to Heat Disinfect Program and allow appropriate time (up to 30 minutes) for symptoms to appear. Is the problem still present?

Yes See procedure number T- 1.0.8 (page 96).

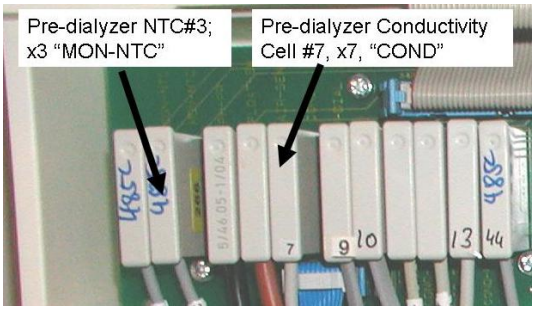
No The BTM may be bad. Check its dip switch settings per its Operator's manual.

T- 1.0.8 VERIFY TEMPERATURE PROBLEM

Depending on where the problem was originally observed, (i.e. **Dialysis** or **Heat Disinfect**), proceed accordingly:

- **Dialysis:** Call the Home screen and proceed accordingly (two scenarios).
  1. **Very unstable and exceeds 41° C at some point:** See procedure number T- 1.3.0 (page 100).
  2. **NEVER exceeds 41° C:** See procedure number T- 1.0.9 (page 96).
- **Heat Disinfect:** Proceed accordingly (four scenarios):
  1. **After five minutes, remains less than 35° C: IMPORTANT!** Place the machine into Dialysis program (remember to press the 'CONFIRM' key) then see procedure number T- 1.0.9 (page 96).
  2. **After thirty minutes, is greater than 35° C but fails to reach 80° C: IMPORTANT!** Return to Heat Disinfect Program then see procedure number T- 3.0.0 (page 111).
  3. **Exceeds (but does not remain) 91° C:** See procedure number T- 1.3.0 (page 100).
  4. **"TEMP OVER 95 DEGREES" message:**
     a) Turn the machine off and allow three minutes.
     b) Place the machine into DIALYSIS program (remember to press the "CONFIRM' key).
     c) See procedure number T- 1.3.0 (page 100).

T- 1.0.9 CHECK DISPLAYS



a) Before continuing, from the Home screen, it is **VERY** important that **Temperature** is **NEVER** reaching 41° C otherwise machine damage may occur!

b) Place the **6.04 KΩ** resistor plug, from the two-resistor OLC set, into the **2nd** distribution board position from the left, labeled "MON-NTC". This is pre-dialyzer temperature sensor (NTC #3).

c) Referring to the Figure (right), place the **274 Ω** resistor plug, from the two-resistor OLC set, into the pre-dialyzer conductivity cell's (#7) distribution board position labeled "COND" (5th **connector cap** from the left).

d) Post a note that the resistor plugs are in. When troubleshooting is complete they **MUST** be removed!

e) From the Home screen, is **Temperature** between 35.1 and 38.9° C?

Yes See procedure number T- 1.1.0 (page 97).

No
a) Per procedure number T- 1.0.9 (page 96) ASSURE the **6.04 KΩ** resistor is placed correctly at distribution board position labeled "MON-NTC"!
b) Turn the HEATER Switch OFF (rocker switch pressed in towards "0" or "OFF").
c) Leaving the resistor plug installed see procedure number T- 5.0.0 (page 118).

T- 1.1.0 CHECK TEMPERATURE ALARM

Referring to the Figure right, with **Temperature** between 35.1 and 38.9° C, is the **Temperature** window RED?

Yes a) ASSURE Temperature is set to 37° C per procedure number T- 1.0.3 (page 93).

b) If the **Temperature** window remains RED, three possibilities: **1)** Bad actuator board; **2)** Bad sensor board; **3)** Bad function board.

No See procedure number T- 1.1.1 (page 97).

T- 1.1.1 CHECK CONDUCTIVITY ALARM

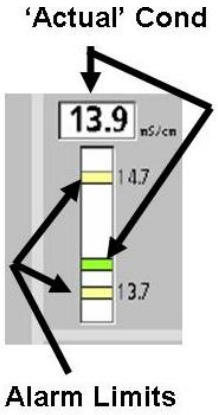
From the Home screen, is the **Conductivity** window RED?

Yes a) Per procedure number T- 1.0.9 (page 96) ASSURE the **274 Ω** resistor plug is placed correctly at distribution board position labeled "COND"!

b) If the **Conductivity** window remains RED, see procedure number T- 1.1.2 (page 97).

No See procedure number T- 1.1.3 (page 97).

T- 1.1.2 CHECK FOR CONDUCTIVITY ALARM



a) Select the 'Dialysate' tab at the bottom of the screen to call the 'CONFIRM Concentrate screen.

b) Using the screen's 'Alarm Position' and/or the 'Alarm Width' buttons are you able to adjust the Alarm Limits until 'actual' conductivity is BETWEEN the upper and lower alarm limits (see Figure right)?

Yes **IMPORTANT!** Press the 'CONFIRM' key then see procedure number T- 1.1.3 (page 97).

No See procedure number T- 1.2.5 (page 99).

T- 1.1.3 CHECK 'OUT OF BYPASS' FUNCTION

a) **IMPORTANT!** ASSURE the shunt door is closed!

b) Is the Bypass LED (front panel) OFF constant?

Yes See procedure number T- 1.1.4 (page 98).

No Repeat from procedure number T- 1.1.0 (page 97), **HOWEVER** if the procedures return here, and all above procedures have been performed correctly, three possibilities: **1)** Bad actuator board; **2)** Bad sensor board; **3)** Bad function board.

T- 1.1.4 CHECK 'OUT OF BYPASS' FLOW

a) From the Home screen set Dialysate flow to 500 ml/min (NOT "a500").

b) **IMPORTANT!** Do NOT reset alarms!

c) Is the external flow indicator's (#75) 'bob' rising (at least ¼ way up) and falling (see Figure right)?

Yes See procedure number T- 1.1.5 (page 98).

No a) CAREFULLY return Conductivity cell #7 and NTC #3 to their distribution board positions (respectively labeled "COND" and "MON-NTC").

b) Proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM.

T- 1.1.5 CHECK 'ACTUAL' TEMPERATURE

a) Place a calibrated external Temperature meter into the dialysate lines.

b) **IMPORTANT!** ASSURE the shunt door is closed and flow through the external flow indicator!

c) Allow the meter to stabilize. Is it reading greater than 35.5° C?

Yes See procedure number T- 1.1.6 (page 98).

No a) **CAREFULLY** return NTC# 3 and Conductivity Cell #7 to their CORRECT distribution board positions respectively labeled "MON-NTC" and "COND".

b) See procedure number T- 1.7.0 (page 103).

T- 1.1.6 CHECK 'ACTUAL' TEMPERATURE STABILITY

a) Allow two minutes for BEFORE continuing!

b) Watch the external **meter** for one minute and NOTE the highest and lowest values.

c) Does the meter's reading vary greater than +/- 0.15° C?

Yes See procedure number T- 1.1.7 (page 98).

No Call debug screen 5. CAREFULLY watch **TPRE** for one minute. Does it vary greater than +/- 2?

Yes See procedure number T- 7.1.1 (page 125).

No Proceed according to the external meter's reading (two scenarios):

1) **Between 35.5° C and 38.5° C:** See procedure number T- 1.1.8 (page 98).

2) **Between 38.5 and 39.9° C:** See procedure number T- 7.0.0 (page 121).

T- 1.1.7 TROUBLESHOOT UNSTABLE TEMPERATURE

Watch the external **meter's** reading for one minute. If it varies greater than +/- 0.15 ° C watch for up to five minutes. Two scenarios:

1) **Exceeds 40.5° C at some point:** CAREFULLY return NTC# 3 and Conductivity Cell #7 to their distribution board positions (respectively labeled "MON-NTC" and "COND") then see procedure number T- 4.0.0 (page 114).

2) **Remains less than 40.5° C:** CAREFULLY return NTC# 3 and Conductivity Cell #7 to their distribution board positions (respectively labeled "MON-NTC" and "COND") then see procedure number T- 6.0.0 (page 119).

T- 1.1.8 CHECK NTC #3

a) CAREFULLY return NTC #3 and Conductivity cell #7 to their distribution board positions respectively labeled "MON-NTC" and "COND".

b) Allow 30 seconds.

c) From the Home screen, is the machine's **Temperature** display greater than 33° C?

Yes See procedure number T- 1.1.9 (page 99).

No Replace NTC #3 (see Figure 42, page 94) then see procedure number T- 7.0.0 (page 121).

T- 1.1.9 CHECK NTC #3 STABILITY

Allow 30 seconds then watch the machine's **Temperature** display for one minute. **At this point it does not matter what the reading is**. Does it vary greater than +/- 0.2° C?

Yes Replace NTC #3 (see Figure 42, page 94) then see procedure number T- 7.0.0 (page 121).

No See procedure number T- 1.2.0 (page 99).

T- 1.2.0 CHECK TEMPERATURE DISPLAY

Is the machine's **Temperature** display between 35.5° C and 38.5° C (i.e. within 1.5 °C of the Temperature setting)?

Yes See procedure T- 1.2.1 (page 99).

No See procedure number T- 7.0.0 (page 121).

T- 1.2.1 CHECK TEMPERATURE AT OTHER FLOW RATES

Check Temperature stability for other applicable Dialysate flow rates as described below. **Read steps a through f before continuing!**

a) From the Home screen, set Dialysate flow to the desired rate then press the 'CONFIRM' key.

b) Re-check loading pressure at each flow rate. If (and ONLY if) it is NOT 'okay' (per **Table 15**, page 93) proceed to **page 18**, procedure number **F- 2.0.4**.

c) Allow **five minutes** for stabilization at flows greater than 200 ml/min. If flow is set to 200 ml/min or less allow **15 minutes**.

d) Call debug screen 0 AND while waiting for stabilization, CAREFULLY watch **Flow Error**. If (and ONLY if) **Flow Error** = 1 (intermittently or constant) proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM. If a "No Water" message appears proceed to **page 64**, SECTION 2 – NO WATER.

e) Call the Home screen if **Temperature** is not remaining stable between 35.5 and 38.5° C see procedure number T- 6.0.0 (page 119).

f) Repeat parts a through f for all applicable flow rates. If Temperature remains stable at all flow rates do NOT continue!

T- 1.2.5 CHECK 'OUT OF BYPASS' FLOW

a) Referring to the Figure (right), CAREFULLY return NTC #3 and Conductivity cell #7 to their distribution board positions respectively labeled "MON-NTC" (**2nd** position from the left) and "COND" (**6th** position from the left).

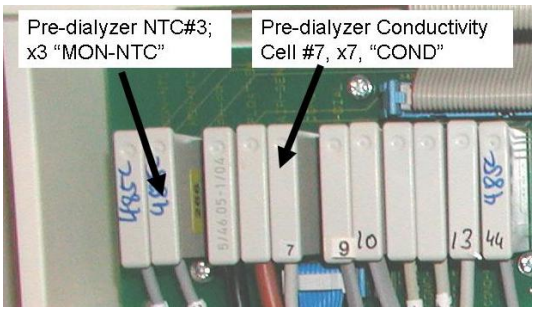
b) Plug the concentrate connectors into their respective rinse ports.

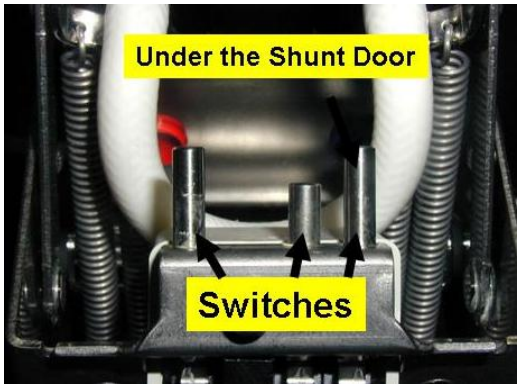
c) Connect the dialyzer connectors to a calibrated Temperature meter.

d) Open the shunt door. Referring to the Figure (right), reach into the opening, under the door, and push down and hold ALL THREE switches.

e) Activate the screen's RINSE button. If all three switches are held Rinse program starts.

f) Release the switches but do **NOT shut the door.** The "Cover is Open" message presents but Rinse program continues.





g) Is the external flow indicator's (#75) 'bob' rising, **at least ½ way up,** and falling?

Yes See procedure number T- 1.2.6 (page 100).

No a) If (and ONLY if) the screen says "Interrupted" repeat procedure number T- 1.2.5 (page 99) from part d.

b) Proceed to **page 49**, procedure number **F- 14.0.2**.

T- 1.2.6 CHECK TEMPERATURE

Allow five minutes, then CAREFULLY watch the external meter's reading for up to five minutes: Proceed accordingly (three scenarios):

1) **Temperature remains less than 35.5° C:** See procedure number T- 1.7.0 (page 103).

2) **Temperature exceeds (but does not remain at) 40.5° C:** See procedure number T- 4.0.0 (page 114).

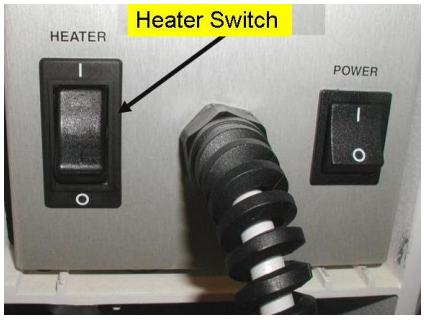
3) **Temperature remains greater than 35.5 but NEVER exceeds 40.5° C:**

a) Calibrate COND CELLS per procedure. If (and ONLY if) the calibration is NOT successful proceed to **page 128**, SECTION 5 – CONDUCTIVITY PROBLEMS.

b) Return to Dialysis program (remember to press the 'CONFIRM' key).

c) If the Temperature problem remains return to procedure number T- 1.0.1 (page 93).

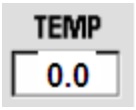
T- 1.3.0 CHECK 'TEMP'



a) **IMPORTANT!** Referring to the Figure (right), turn the HEATER switch **OFF** (rocker switch pressed in towards "0" or "OFF"). **Leave it off until instructed otherwise!**

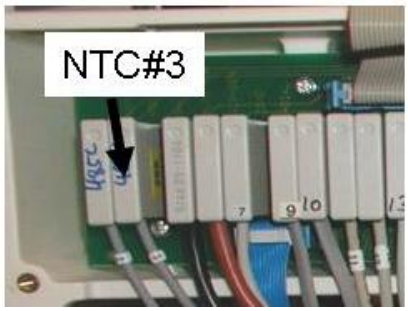
b) Referring to the Figure (below, right), unplug the connector from distribution board position labeled "MON-NTC" (**2nd position from the left**). This is temperature monitor sensor NTC #3.

c) Call debug screen 4. Is **TEMP** less than 0.3?



Yes See procedure number T- 1.3.1 (page 101).

No No likely! ASSURE the connector at distribution board position labeled "MON-NTC" (**2nd position from the left**) was unplugged. If (and ONLY if) it IS unplugged see procedure number T- 7.1.1 (page 125).



T- 1.3.1 CHECK TEMPERATURE DISPLAY FOR 80° C

a) Place the **34° C** (6.808 KΩ) resistor plug, from the four-resistor Temperature set into vacant distribution board position "MON-NTC" (**2nd position from the left**).

b) From the Home screen, is **Temperature** between 33 and 35° C **AND** stable (i.e. does not vary more than +/- 0.2° C)?

Yes See procedure number T- 1.3.3 (page 101).

No a) ASSURE the **34°C** (6.808 KΩ) resistor plug is placed properly at distribution board position "MON-NTC". If not, repeat procedure number T- 1.3.1 (page 100).

b) See procedure number T- 1.3.2 (page 101).

T- 1.3.2 CHECK TEMPERATUE DISPLAY CIRCUITS

a) Enter Service Mode → Calibrate Sensors → Temp Sensors. **IMPORTANT!** Two checks while performing this calibration. Read both then proceed with the Temp Sensors calibration:

1. The [Pre-Temperature Reference] data box value should increase with each resistor plug per Table K (page 101) if (and ONLY if) the CORRECT resistor plug is used **AND** the Temperature monitoring circuit is working properly otherwise an "Operator Error" message occurs.
2. After installing each resistor plug and **BEFORE** pressing the 'CONFIRM' key, the [Pre-Temperature Reference] data box value should NOT vary more than +/- 2.

Table K - Pre Temperature Reference Values

First Resistor: 34° C = 6.808 KΩ Pre-Temperature Reference value = 70 +/- 6	**Third Resistor:** 80° C = 1.255 KΩ Pre-Temperature Reference value = 198 +/- 6
Second Resistor: 41° C = 5.117 KΩ Pre-Temperature Reference value = 163 +/- 6	**Fourth Resistor:** 90° C = 0.915 KΩ Pre-Temperature Reference value = 210 +/- 6

b) Were both of the above checks for all four resistor plugs okay?

Yes — Press the 'CONFIRM' key twice to save the calibration then see procedure number T- 1.3.3 (page 101).

No — Turn the machine off back on and CAREFULLY repeat the Temp Sensor calibration. If the problem still exists see procedure number T- 7.1.1 (page 125).

T- 1.3.3 CHECK TEMPERATURE PROBLEM

a) **IMPORTANT!** Referring to the Figure (previous page) CAREFULLY return the original connector (NTC #3) to distribution board position "MON-NTC" (**2nd position from the left**).

b) Plug the concentrate connectors to their respective rinse ports.

c) Place the machine into Rinse Program.

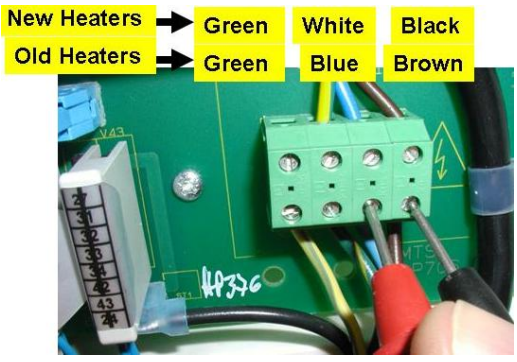
d) Referring to the Figure (right), CAREFULLY place the **80° C** (1.255 KΩ) resistor plug from the four-resistor Temperature set, into the **1st** distribution board position from the left, labeled "CON-NTC". This is temperature control sensor NTC #2.

e) **CAUTION! 120 Volts AC possible!** Referring to the Figure (below, right), measure **AC voltage** (~ V), at the distribution board's heater connector, between the: **Old style heaters**: BROWN and BLUE wires; **New style heaters:** BLACK and WHITE wires. If the 80° resistor plug was placed correctly there should be less than 10 Volts (i.e. heater off).

f) Call debug screen 5 to watch **TPRE**. Allow up to 20 minutes as it may take a while for Temperature to decrease. **Be patient to avoid error!** Does T**PRE** decrease to 3900 or less?

Yes — See procedure number T- 1.3.4 (page 102).

No — Replace NTC #3 (see Figure 42, page 94) then proceed to T- 7.0.0 (page 121).



T- 1.3.4 CHECK TEMPERATURE CONTROL

a) **IMPORTANT!** Turn the HEATER switch on (rocker switch pushed into "1" or "ON".

b) **ASSURING TPRE is 4000**, measure **AC voltage** (~ V), at the distribution board's heater connector, between the: **Old style heaters**: BROWN and BLUE wires; **New style heaters:** BLACK and WHITE wires.

c) Is the measurement greater than 90 volts AC?

Yes a) Connect to concentrate and return to Dialysis program (remember to press the 'CONFIRM' key).

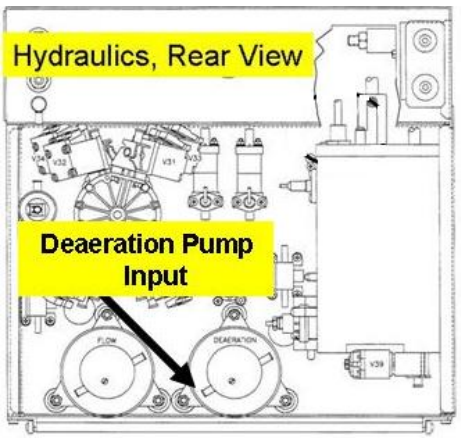
b) See procedure number T- 4.0.0 (page 114).

No If SURE the meter is set to measure **AC voltage** (~ V), AND the HEATER switch is ON, proceed according to the originally observed symptom:

- **Temperature exceeded (but does not remain) 41° C in Dialysis Program:** Replace NTC #3 (see Figure 42, page 94) then proceed to T- 7.0.0 (page 121).
- **Exceeds (but did not remain) 91° C in Heat Disinfect Program:** See procedure number T- 1.3.5 (page 102).
- **"TEMP OVER 95 DEGREES" message occurred in Heat Disinfect Program:** See procedure number T- 1.3.5 (page 102).

T- 1.3.5 CHECK VALVE #39

This procedure checks if valve #39 is opening by checking deaeration pressure. **IMPORTANT! Assure the deaeration gauge reads 0 inHg before installing it!**



a) **IMPORTANT!** Remove the **80° C** resistor plug from the distribution board and return NTC #2's connector to position labeled "CON-NTC", 1st connector from the left.

b) Pull the red connector from its rinse port to interrupt Rinse.

c) Referring to the Figure (right), tee the deaeration gauge into the clear input tubing of deaeration pump #20.

d) Place the machine into Rinse program. Is pressure between 0 and -15 inHg?

Yes See procedure number T- 1.3.6 (page 102).

No Valve #39 is remaining closed! Proceed to **page 73,** procedure number **CLEAN- 2.0.4**.

T- 1.3.6 VERIFY PROBLEM

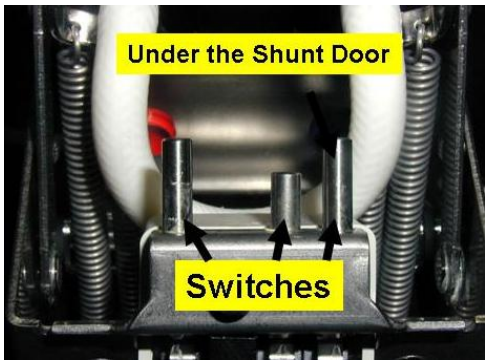
a) Pull the red concentrate connector from its port to interrupt Rinse and remove the gauge.

b) Install all panels but do not screw them in.

c) Connect the dialyzer connectors to a calibrated Temperature meter.

d) Open the shunt door open. Referring to the Figure (right), reach into the opening, under the door, and push down and hold ALL THREE switches.

e) Activate the screen's HEAT DISINFECT button. If all switches are held Heat Disinfect Program starts.



f) Release the switches but do **NOT shut the door**. The "Cover is Open" message presents but Heat Disinfect Program continues.

g) CAREFULLY watch the external meter for up to 35 minutes. If (and ONLY if) using a NEO-1* greater than 71° C = greater than 90° C. Other meters read directly. Does the meter's reading EVER reach 90° C or greater?

Yes Replace NTC #2 (see Figure 42, page 94) then see procedure number T- 7.0.0 (page 121).

No Replace NTC #3 (see Figure 42, page 94) then see procedure number T- 7.0.0 (page 121).

* The NEO-1 is not linear at high temperatures! **If possible, do NOT use a NEO-1 for this check!**

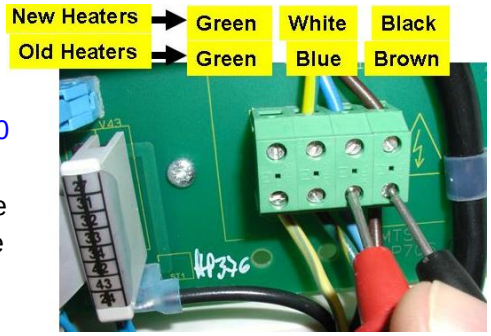
T- 1.7.0 CHECK HEATER VOLTAGE

a) ASSURE the HEATER switch is ON (rocker switch pushed into "1" or "ON")!

b) Referring to the Figure (right), unplug the connector from the **1st** distribution board position from the left (labeled "CON-NTC"). This is temperature control NTC #2 and NOW the heater should be on fully.

c) Using a flashlight, CAREFULLY check **inside** the vacant "CON-NTC" position for 'white' corrosion or damaged **male** pins that may cause false signals.

d) **CAUTION! 120 Volts AC!** Referring to the Figure (right), measure **AC voltage** (~ V), at the distribution board's heater connector, between the: **Old style heaters**: BROWN and BLUE wires; **New style heaters:** BLACK and WHITE wires.



e) Proceed accordingly (two scenarios):

1. **Greater than 90 volts AC:** See procedure number T- 1.8.0 (page 103).
2. **Less than 10 volts AC:** If sure the meter is set to measure **AC voltage** (~ V), AND measuring correctly see procedure number T- 2.0.0 (page 104).

T- 1.8.0 CHECK NTC #2

a) CAREFULLY return NTC #2 to the **1st** distribution board position from the left (labeled "CON-NTC").

b) Measure AC voltage (~ V) again at the distribution board's heater connector. Is it greater than 90 volts AC now?

Yes See procedure number T- 1.9.0 (page 103).

No Replace NTC #2 (see Figure 42, page 94) then see procedure number T- 7.0.0 (page 121).

T- 1.9.0 CHECK TEMPERATURE DISPLAY

From the Home screen, watch Temperature **IMPORTANT** for up to **five minutes**. Does it increase to 30° C or greater?

Yes See procedure number T- 7.0.0 (page 121).

No Replace NTC #3 (see Figure 42, page 94) then see procedure number T- 7.0.0 (page 121).

T- 2.0.0 HEATER VOLTAGE LESS THAN 20 VAC - CHECK LOGIC SIGNALS

CAUTION! DC Voltages will be measured at pins that are close together and 'shorting' them with a regular meter probe may damage boards. It is HIGHLY RECOMMENDED the Fluke TP 80 meter probe (or equivalent), together with the protective cap (see Figure 5, page 11) is used!

a) **IMPORTANT!** Post a note that NTC #2 is unplugged. It MUST be returned after the problem is located and/or before Temperature calibrations but leave it unplugged for now.

b) Open the card cage. Attach a volt meter's ground (black) lead to chassis ground (see Figure 1, page 3).

c) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

d) Referring to Figure 44 (page 104), at the top of the power logic board is the 'X2' connector. The solder (rear) side pins are in two rows. From the rear of the machine, the top row are even numbered pin (2, 4, etc), the bottom are odd numbered (1, 3, etc).

e) Assuring Dialysate flow in ON (Dialysate Flow on/off LED off), **using Fluke TP 80**, measure DC voltage at the solder (rear) side of the pin(s) as specified in Table 16 (page 104) and follow the directions given:

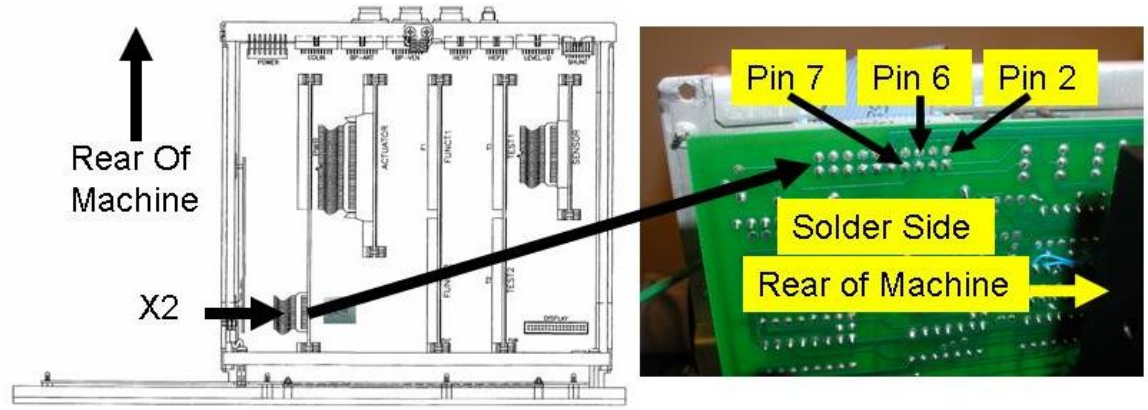


Figure 44 – Electronic Card Cage (Power Logic Board)

Table 16 - Power Logic Heater Signals

PIN #	X2 LOCATION	GOOD SIGNAL (Volts DC):	BAD SIGNAL (Volts DC):
6	Top row, three pins from rear of machine	9.6 or greater, measure at pin #7 (**next row in this table**)	3.6 or lower, see procedure number T- 2.1.0 (page 105)
7	Bottom row, four pins from rear of machine	4.0 or greater, measure at pin #2 (**next row in this table**)	3.0 or lower, see procedure number T- 2.2.0 (page 106)
2	Top row, first pin from Rear of machine	2.0 or lower, if ALL three pins check okay see procedure number T- 2.4.0 (page 108)	9.0 or greater, see procedure number T- 2.3.0 (page 106)

T- 2.1.0 CHECK SENSOR BOARD SIGNAL

a) Referring to Figure 45 (page 105), at the bottom of the **sensor board** a row of pins extend horizontally, turn 90 degrees downward and plugs into the motherboard connector. This is the "C" row, numbered 1 through 32 (from front-to-rear) Using a **regular meter probe** (**do NOT use TP 80**)!

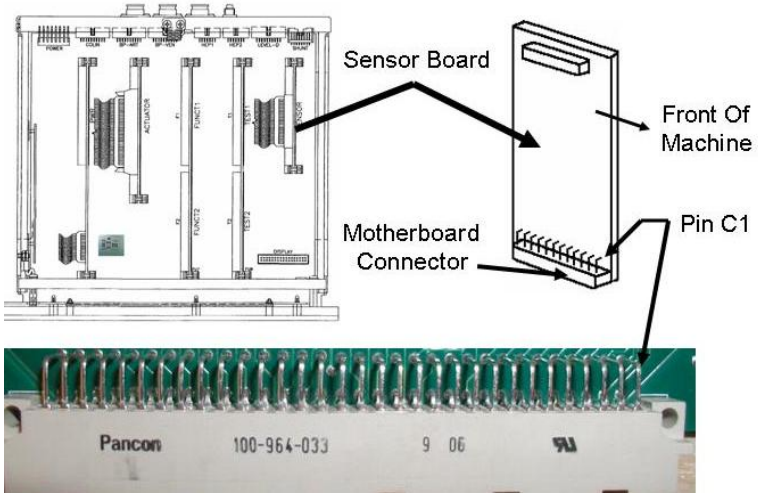


Figure 45 – Electronic Card Cage (Sensor Board, Pin C1)

b) CAREFULLY measure DC voltage at *pin C1* (very front motherboard pin). **Do not to contact adjacent pins!** Proceed accordingly:

- **9.6 or greater:** See procedure number T- 2.1.1 (page 105)
- **Between 3.7 and 5.5:** Assure you are not contacting adjacent pin C2
- **3.6 or lower:** Replace the power logic board (see Figure 4A and NOTE B, page 8).

T- 2.1.1 CHECK NTC #2 CIRCUIT

a) Turn the machine off! Swap in a known good power logic board (see Figure 4A and NOTE B, page 8).

b) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

c) Measure DC voltage again at the sensor boards motherboard *pin C1.* Proceed accordingly:

- **9.6 or greater:** The previous power logic board is good. See procedure number T- 2.1.2 (page 105).
- **Between 3.7 and 9.5:** Assure you are not contacting adjacent pin C2.
- **3.6 or lower:** The previous power logic board is bad. Return NTC #2 to distribution board position "CON-NTC" (**1st** position from the left). Temperature should become normal after eight minutes.

T- 2.1.2 CHECK SENSOR BOARD

a) Return NTC #2 to distribution board position "CON-NTC" (1st position from the left).

b) Turn the machine off and swap in a known good sensor board (see Figure 4A, page 8).

c) From Service Mode, select Calibrate Sensors → Temp Control. Are you able to adjust Temperature on the external meter to 37° C?

Yes The previous sensor board is bad. Perform all calibrations per procedure.

No Perform INITIAL CHECKS (page 6). The distribution board may be bad.

T- 2.2.0 CHECK FOR FLOW ERRORS / NO WATER

Call debug screen 0. Is **Flow Error** = 1 **OR** is a "No Water" message presenting itself?

Yes Proceed accordingly:

- **"No Water" message:** Proceed to page 64, SECTION 2 - NO WATER
- **Flow Error = 1:** Proceed to page 14, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM

No Three possibilities: 1) Bad actuator board (see Figure 4A, page 8); 2) Bad power control board (inside the power supply); 3) Bad motherboard.

T- 2.3.0 CHECK THE POWER CONTROL BOARD (DIODE #17)

a) Call debug screen 0. ASSURE **Flow Error** = 0 constant. ASSURE a "No Water" message is not presenting!

b) Turn the power off and unplug the machine. **Caution! High Voltage if not unplugged!**

c) Referring to Figure 306 (page 106) open the power supply to access the component side of the power control board.

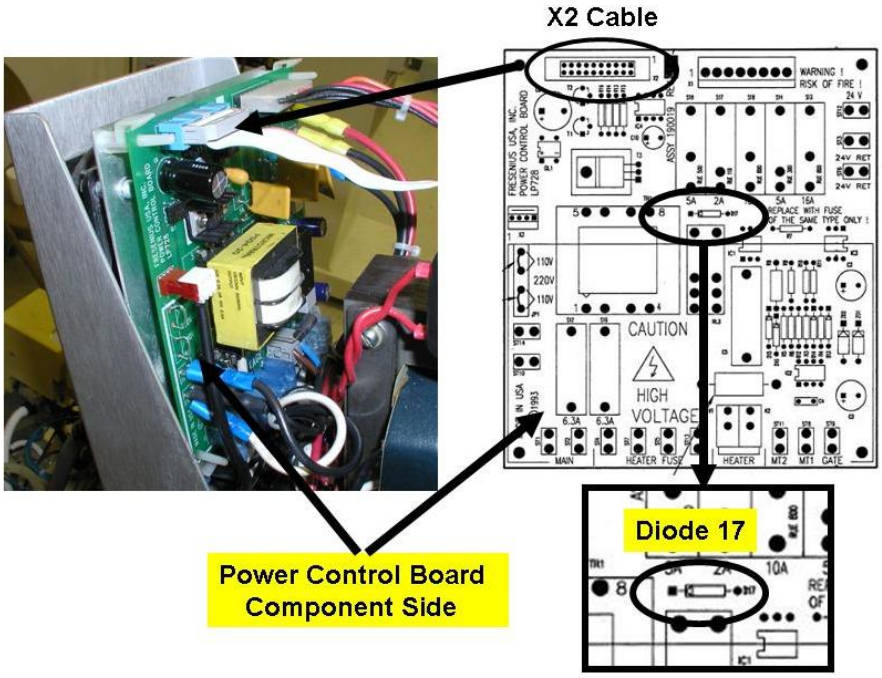


Figure 306 – Power Control Board / Diode 17

d) **Unplug the X2 cable from the top of the power control board**.

e) A bad diode 17 may damage the power logc board. Referring to Figure 306 (page 106), check diode 17's resistance (Ω)***** by placing the meter leads on either side of it.

* NOTE: The meter's diode check function will not work because the diode is 'in circuit'

f) Is the meter's numeric AND units display indicating a resistance between 500 and 1500 Ω (or between 0.50 KΩ and 1.5 KΩ)?

Yes a) Reconnect the X2 cable to the power control board.

b) How to proceed depends upon if 'clip on' meter leads are available (see Figure 5, page 11):

- **Clip on leads NOT available:** See procedure number T- 2.3.1 (page 107)
- **Clip on leads ARE available:** See procedure number T- 2.3.2 (page 107)

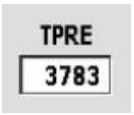
No Replace the power control board (or diode 17 (1N914B)). The power logic board is probably also bad (see Figure 4A and NOTE B, page 8).

T- 2.3.1 CHECK POWER LOGIC BOARD (WITHOUT CLIP ON METER LEAD)

a) Swap in a known good power logic board (see Figure 4A and NOTE B, page 8).

b) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

c) Call debug screen 5. After no more than five minutes, does **TPRE** (middle column, top) increase to 3600 or greate?



Yes The previous power logic board is bad (see Figure 4A and NOTE B, page 8).

No a) Return NTC #2 to distribution board position "CON-NTC" (1st position from the left).

b) Turn the machine off and swap in a known good function board (see Figure 4A and NOTE B, page 8). Assure EEPROM (IC2) is installed.

c) From Service Mode, select Calibrate Sensors → Temp Control. Are you able to adjust Temperature on the external meter to 37° C?

Yes The previous function board is bad. Perform all calibrations.

No Three possibilities: 1) Bad sensor board cable; 2) Bad power logic board; 3) Bad motherboard.

T- 2.3.2 CHECK POWER LOGIC BOARD B (WITH CLIP ON METER LEAD)

a) Referring to Figure 46 (page 107), at the bottom of the **power logic board** a row of pins extend horizontally, turns 90 degrees downward, and plugs into the motherboard connector. This is the "C" row.

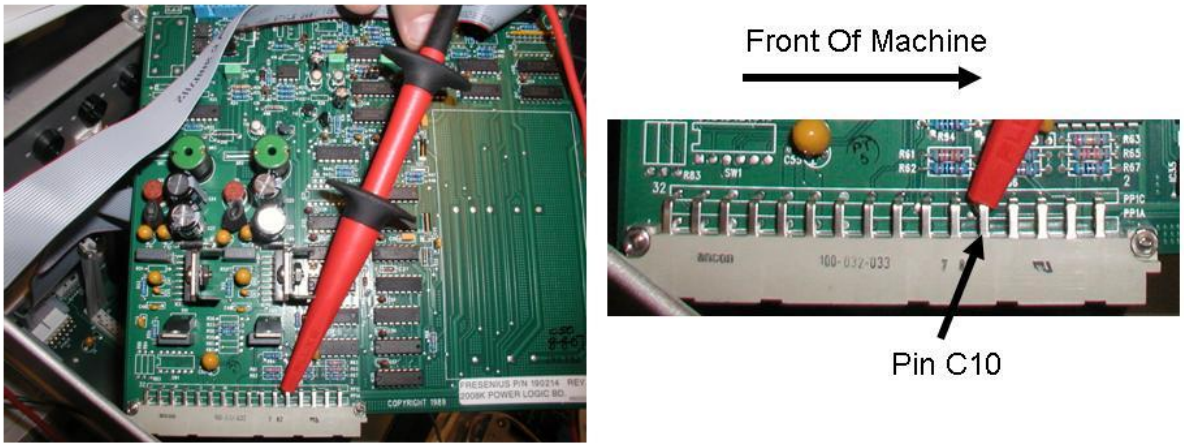


Figure 46 – Electronic Card Cage (Power Logic Board, Pin C10)

b) Remove the power logic board from the card cage and clip a meter lead onto motherboard *pin C10* (**fifth** pin from the front of the machine).

c) Reinstall the board keeping the meter lead vertical. **ASSURE the meter lead is not contacting adjacent pins!**

d) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

e) **IMPORTANT!** Allow 10 seconds for the heater relay to turn on!

f) Is the voltage measurement 4 volts DC or greater?

Yes Replace the power logic board (see Figure 4A and NOTE B, page 8).

No See procedure number T- 2.3.3 (page 108).

T- 2.3.3 CHECK FUNCTION BOARD SIGNAL (HEAT)

Leave the meter lead at *pin C10* for now. Call debug screen 2. Is **HEAT** (second column from the right) = 1?

Yes See procedure number T- 2.3.4 (page 108).

No a) Assure a "No Water" message is absent.

b) Call debug screen 0. Assure that **Flow Error** = 0 (constant).

T- 2.3.4 CHECK FUNCTION BOARD

a) Turn the machine off and swap in a known good function board (see Figure 4A, page 8). Assure that EEPROM (IC2) is installed.

b) Enter Service Mode → Options → Hardware Options. Set T and C (Test and Calibration) to "Yes". Press the 'CONFIRM' key (the "x" turns blue).

c) Return to Dialysis program (remember to press the 'CONFIRM' key). Is the voltage measurement at *pin C10* four (4) volts DC or greater?

Yes The previous function board is bad. Perform all calibrations.

No If debug screen 2, **HEAT** = 1 the motherboard may be bad.

T- 2.4.0 CHECK HEATER RELAY

a) Turn the machine off and back on. Allow the "Select Program" screen to come up.

b) **IMPORTANT**! Do **NOT** press the 'CONFIRM' key. With "Select Program" screen REMAINING up.

c) Using **Fluke TP 80**, measure again at the solder side of the power logic board's 'x2' connector, *pin 2* (top row, first pin from rear). Greater than 20 volts DC?

Yes See procedure number T- 2.6.0 (page 109).

No See procedure number T- 2.5.0 (page 108).

T- 2.5.0 CHECK POWER LOGIC CABLE (X2) / POWER CONTROL BOARD

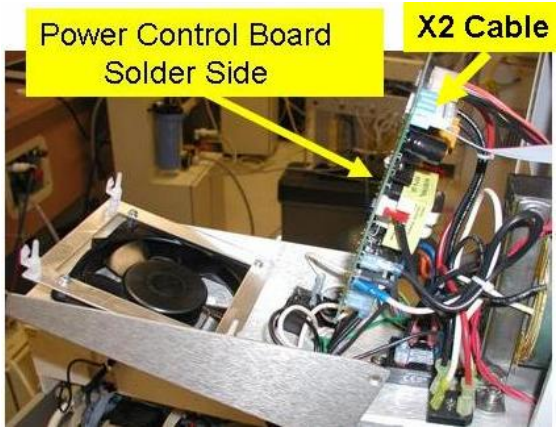
This procedure checks power logic cable (X2) resistance (Ω) from one end to the other. A good cable measures 2 **Ω** or less:

a) Turn the machine off and **UNPLUG** it. **CAUTION! Electrocution hazard if not unplugged!**

b) Referring to the Figure (right), lay the power supply rear panel down to access the rear (solder) of the **power control board**.

c) The X2 cable runs between the power control and the power logic board. **ASSURE it is plugged in securely at both ends.**

d) Touch the meter leads together and subtract the meter's resistance (Ω) reading from subsequent readings.



e) Referring to Figure 47 (page 109), measure resistance at the rear (solder) between:

Pin 2, at the Power Logic Board's end (**top row**, first pin from rear)

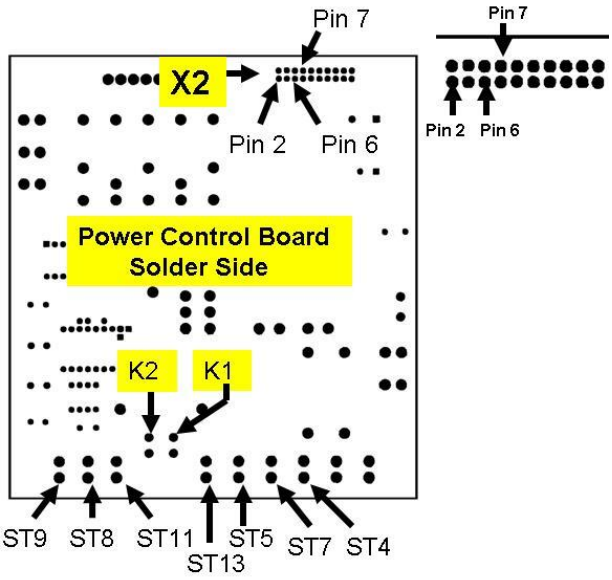
AND

Pin 2 at the Power Control Board's end (**bottom row**, first pin from the left).

f) Is the meter's numeric AND units display indicating 2 **Ω** or less?

Yes Unplug the machine and replace the power control board (inside the power supply).

No Unplug the machine and replace the power logic cable.



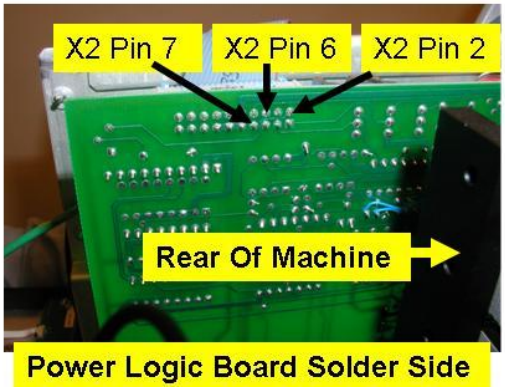


Figure 47 – Power Control Board / Power Logic Board

T- 2.6.0 CHECK THE POWER LOGIC BOARD CABLE (X2)

This procedure checks power logic cable resistance (Ω) from one end to the other specifically at pins 6 and 7. A good cable measures 2 **Ω** or less:

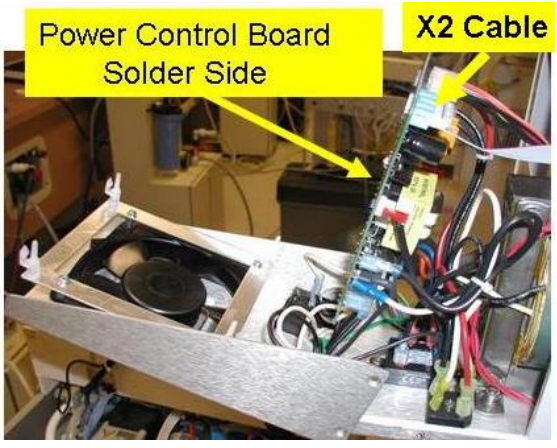
a) Turn the machine off and **UNPLUG** it. **CAUTION! Electrocution hazard if not unplugged!**

b) Referring to the Figure (right) lay the power supply rear panel down to access the rear (solder) side of the **power control board**.

c) The X2 cable runs between the power control and the power logic board. **ASSURE it is plugged in securely at both ends.**

d) Touch the meter leads together and subtract the meter's resistance (Ω) reading from ALL subsequent readings.

e) Referring to Figure 47 (page 109), measure resistance BETWEEN (two measurements, pin 6 and pin 7):



1. ***Pin 6***, at the Power Logic Board's end of the cable (**top row**, three pins from rear)

   AND

   Pin 6 at the Power Control Board's end of the cable (**bottom row**, three pins from the left)

2. ***Pin 7***, at the Power Logic Board's end of the cable (**bottom row**, four pins from rear)

   AND

   Pin 7 at the Power Control Board's end of the cable **(top row**, four pins from the left)

f) Is the meter's numeric AND units display, for both measurements, indicating 2 **Ω** or less?

Yes See procedure number T- 2.6.1 (page 110).

No Replace the power logic cable

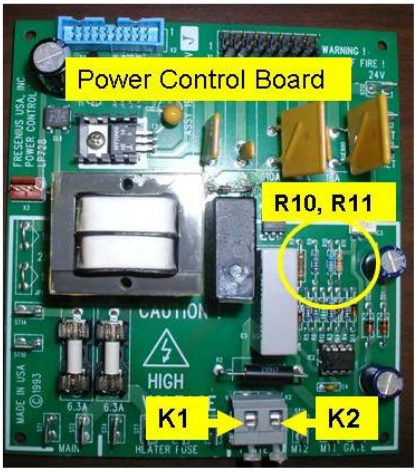
T- 2.6.1 CHECK FOR AN 'OPEN' TRIAC

a) Plug the machine in. **CAUTION!! 120 VOLTS NOW PRESENT!**

b) Place the machine into Dialysis Program (remember to press the 'CONFIRM' key) and (**IMPORTANT!**) wait 30 seconds.

c) Referring to Figure 47 (page 109), **CAREFULLY! (High Voltage),** measure AC (~) voltage at the SOLDER (rear) side of the power control board, BETWEEN connectors ST8 and ST11.

d) Greater than 90 volts AC?



Yes The triac is bad. Referring to Figure 51 (page 116), unplug the machine and replace it (trace the orange wire from ST 9 to it). **IMPORTANT NOTES! 1)** The triac's wires are position sensitive; **2)** The bad triac probably burned resistors R10 and R11 on the power control board. It is probably necessary to replace the board.

No See procedure number T- 2.7.0 (page 110).

T- 2.7.0 CHECK HEATER CONNECTIONS (K1 AND K2)

a) Turn the machine off and **UNPLUG** it. **CAUTION! Electrocution hazard if not unplugged!**

b) Touch the meter leads together and subtract this value from subsequent resistance (Ω) readings.

c) Referring to Figure 47 (page 109), measure resistance (Ω), at the SOLDER (rear) side of the power control board, BETWEEN connectors K1 and K2. Is the meter's numeric AND units display indicating less than 20 **Ω**?

Yes See procedure number T- 2.7.1 (page 110).

No Referring to the Figure (above, right), check the wires for an 'open circuit' between the power control board K1 and K2 connections and the distribution board's 8-pin heater connector.

T- 2.7.1 CHECK HEATER SWITCH

a) Referring to Figure 47 (page 109), measure resistance (Ω) on the SOLDER (rear) side of the power control board. Two measurements:

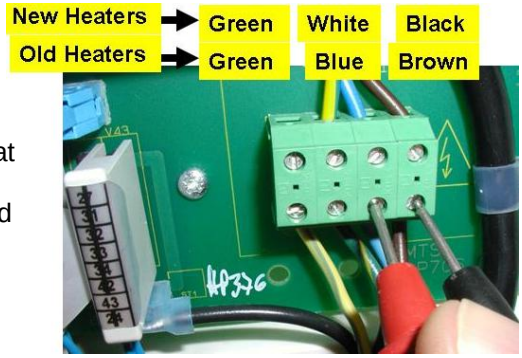
1. **Between ST 7 AND ST 13**
2. **Between ST 4 AND ST5**

b) Is the meter's numeric AND units display, for both measurements, indicating less than 2 **Ω**?

Yes See procedure number T- 2.7.2 (page 111).

No The Heater Switch is bad ('open').

T- 2.7.2 CHECK HEATER VOLTAGE



a) Return to Dialysis program (remember to press the 'CONFIRM' key).

b) Referring to the Figure (right), measure **AC voltage** (~ V), at the distribution board's heater connector, between the: **Old heater:** BROWN and BLUE wires; **New heater:** BLACK and WHITE wires.

c) Greater than 90 volts AC?

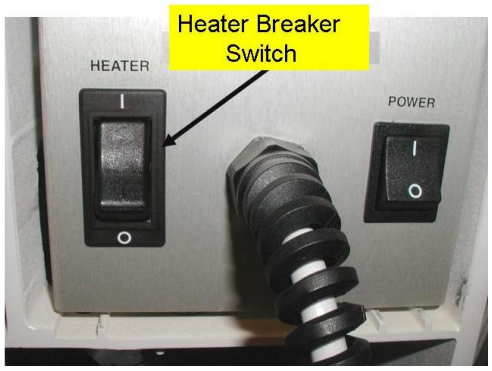
Yes All temperature systems are checking okay:

a) Return NTC #2 to distribution position "CON-NTC" (**1st** position from left).

b) If the problem reoccurs, return to procedure number T- 1.0.0 (page 93) and be careful.

No Replace the power control board (inside power supply).

T- 3.0.0 CHECK TEMPERATURE DISPLAY RESPONSE



This procedure allows the heater to cool to check the test board:

a) Referring to the Figure (right), turn the HEATER switch off (i.e. rocker switch pressed in towards "0" or "OFF").

b) From the Heat Disinfect screen, watch Temperature closely. **IMPORTANT!** Allow up to **20 minutes**. Does it drop to 35° C or lower?

Yes Leaving the HEATER Switch off, see procedure number T- 3.0.2 (page 111).

No Leave the HEATER switch off see procedure number T- 3.0.1 (page 111).

T- 3.0.1 ISOLATE THE TEST BOARD

a) Turn the **machine off**.

b) Swap in a known good test board (see Figure 4A AND NOTE C, page 8).

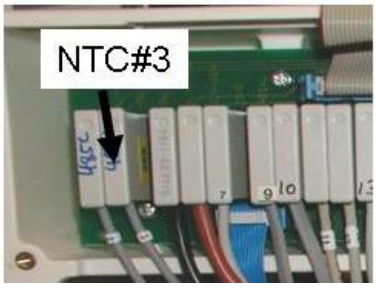
c) Return to Heat Disinfect program and allow **20 minutes**. Does Temperature drop to 35° C or lower?

Yes The previous test board was bad.

No a) The previous test board is okay.

b) A problem is indicated with the Temperature display. Turn the HEATER switch ON then see procedure number T- 7.0.0 (page 121).

T- 3.0.2 CHECK TEMPERATURE DISPLAY



a) Referring to the Figure (right), place the **80° C** resistor plug (1.255 KΩ), from the four-resistor Temperature set, into NTC #3's distribution board position "MON-NTC" (**2nd position from the left**).

b) From the Heat disinfect screen, does Temperature read between 78 and 82° C?

Yes See procedure number T- 3.0.3 (page 112).

No a) ASSURE the **80°C** plug (1.255 KΩ) is placed properly. If not, repeat procedure number T- 3.0.2.

b) Calibrate Temp Sensor per procedure then return to Heat Disinfect. If the problem reoccurs see procedure number T- 3.0.3 (page 112).

T- 3.0.3 CHECK DRAIN FLOW / RECIRCULATION

CAUTION! Potential hot fluid!

a) Carefully return NTC #3 to distribution board position x3, "MON-NTC", **SECOND** position from the left.

b) Referring to the Figure (right), at the far end of the drain tubing, if a 'quick connector' is present, an adaptor IS required to allow flow. Another option is to remove the 'quick connector'.

c) Remove the UF Sample Connector from its port and allow it to dangle. This prevents pressure buildup in subsequent procedures.

d) Referring to the Figure 48 (page 112), tightly clamp the tubing at recirculation valve #29. **Ignore flow errors for now!**

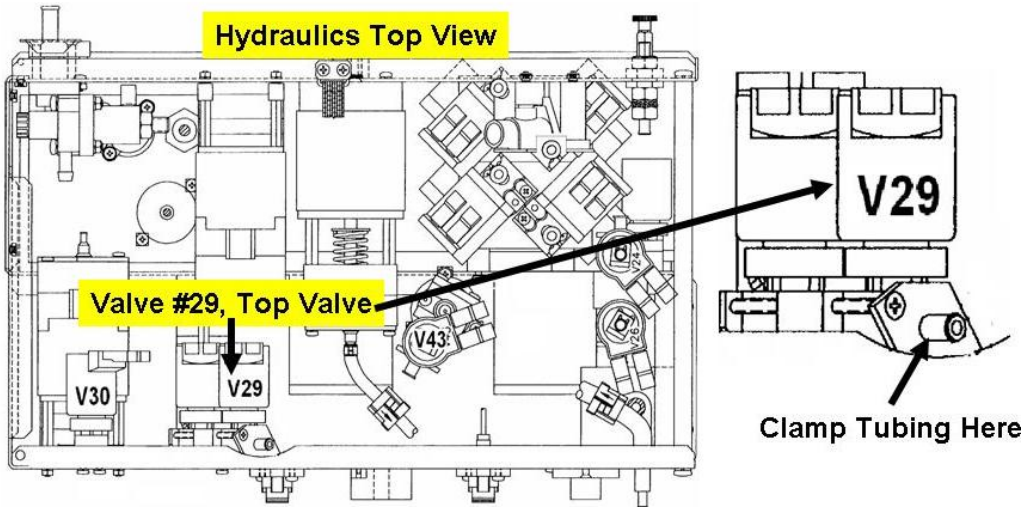
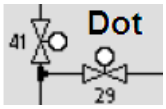


Figure 48 – Valve #29

e) **IMPORTANT!** Referring to the Figure (right), hold the drain tubing so that its opening is pointed **UPWARD** at approximately 45°.



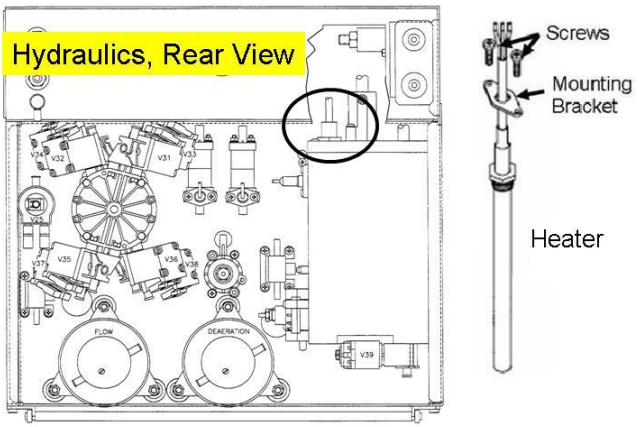
f) Call debug screen 0. If Pre-Rinse time has expired valve #29's dot = blue constant. If not ALLOW valve #29's dot to turn blue, approximately every 100 seconds, for 9 seconds only.

g) Is there flow to drain WHEN valve #29's dot is BLUE?

Yes Unclamp valve #29. Two possibilities: 1) Bad actuator board; 2) Bad valve #30 (see Figure 35 A, page 79).

No Unclamp valve #29 then see procedure number T- 3.0.4 (page 113).

T- 3.0.4 CHECK HEATER



a) **IMPORTANT!** Turn the machine off.

b) Referring to the Figure (right) remove the screws and rotate the heater 180°. **Tighten the bracket screws evenly**. The heater **MUST** be positioned perfectly vertical to maintain proper flow geometry around it.

c) ASSURE incoming water (RO source) temperature is greater than 10° C (50° F).

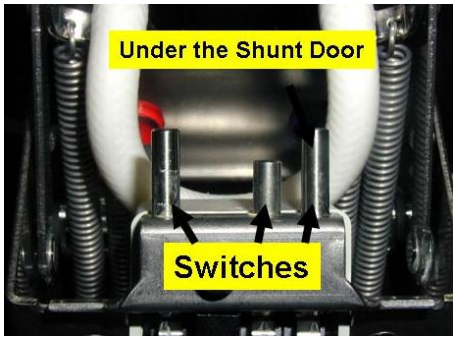
d) See procedure number T- 3.0.5 (page 113).

T- 3.0.5 CHECK TEMPERATURE

a) Return both rear panels however there is no need to screw them in yet.

b) **IMPORTANT!** Turn the HEATER switch ON!

c) Connect an external Temperature meter to the dialysate lines. **CAUTION! The quick connectors may be hot!**



d) Open the shunt door. Referring to the Figure (right), reach into the opening, under the door, and push and hold down ALL THREE switches.

e) Activate the screen's HEAT DISINFECT button. If all three switches are held the Heat Disinfect program starts.

f) Release the switches but do **NOT shut the door!** The "Cover Is Open" message appears **but** Heat Disinfect Program continues!

g) **IMPORTANT!** If (and ONLY if) using a NEO-1* meter refer to the Table I (page 113).

h) Allow up to 25 minutes for the meter's ('actual') Temperature reading to **stabilize**.

*** NEO-1 meters are not linear at high temperatures. If possible, do NOT use a NEO-1 for this check. Other meters read temperature directly!**

i) Does the meter's Temperature reading reach between 80 and 90° C?

Yes Calibrate Temp Control per procedure then return to Heat Disinfect. If the problem still reoccurs four possibilities: 1) Bad NTC #3 (see Figure 42, page 94); 2) Bad sensor board; 3) Bad function board; 4) Bad motherboard.

No See procedure number T- 3.0.6 (page 114).

Table I - NEO-1 Meter Temperature Conversion

NEO-1 Display	Actual Temperature
67.0° C	76 +/- 4° C
68.5° C	80 +/- 4° C
70.0° C	84 +/- 4° C
71.5° C	88 +/- 4° C

T- 3.0.6 CHECK NTC #2

a) Referring to the Figure (right), unplug the connector at the **1st** distribution position from the left (labeled "CON-NTC"). This is temperature controls sensor NTC #2.

b) Continue to CAREFULLY watch the external meter for 20 minutes. Do **NOT let Temperature exceed 90° C!** Does the meter's temperature reading reach 80° C or greater?

Yes a) Return NTC #2's connector to the **1st** distribution position from the left, labeled "CON-NTC".

b) See procedure number T- 7.0.0 (page 121).

No Replace the heater.

T- 4.0.0 CHECK TEMPERATURE CONTROL (NTC #2)

a) Referring to the Figure (above, right), CAREFULLY place***** the **80° C** (1.255 KΩ), resistor plug from the four-resistor Temperature set, into the **1st** distribution board position from the left (labeled "CON-NTC"). **IMPORTANT! Leave the resistor plug in until instructed otherwise!**

***** It may have already been placed from a previous procedure!

b) Open the card cage and place a volt meter's ground (black) lead onto chassis ground (see Figure 1, page 3).

c) Referring to Figure 49 (page 114), at the bottom of the **SENSOR** board a row of pins extend horizontally, turns 90 degrees downward, and connects to the motherboard. This is the "C row", numbered 1 through 32 (from front-to-rear).

d) Using a **regular meter probe** (**do NOT use Fluke TP 80**), CAREFULLY measure DC volts at *pin C1* (very FRONT motherboard pin). Proceed accordingly:

- **9.6 or greater:** See procedure number T- 4.1.0 (page 115).
- **Between 3.7 and 9.5:** Assure you are not contacting adjacent pin C2.
- **Less than 3.6:** a) ASSURE the **80° C** plug is placed correctly before continuing! If not repeat T- 4.0.0 (page 114).

  b) See procedure number T- 4.7.0 (page 117).

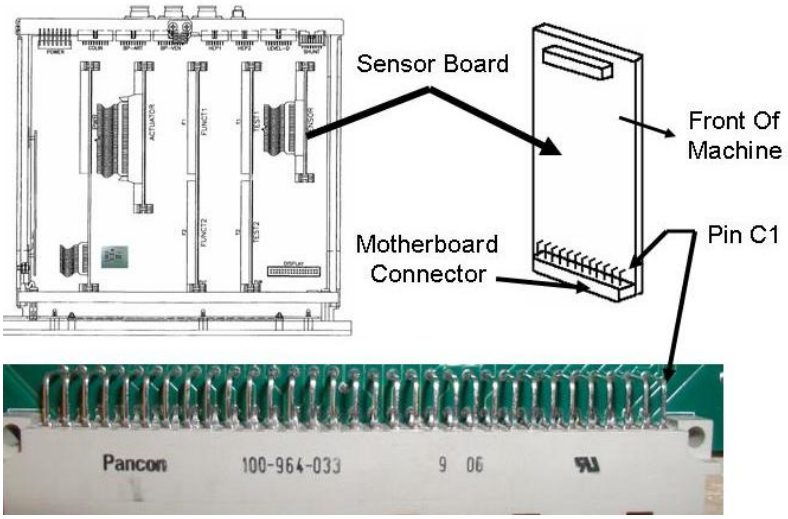
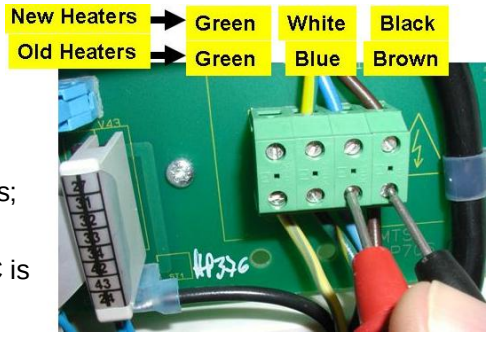


Figure 49 – Sensor Board / Pin C1

T- 4.1.0 CHECK TEMPERATURE



a) **IMPORTANT!** From the Home screen, allow **Temperature** to decrease to less than 40° C.

b) **CAUTION! High Voltage!** Referring to the Figure (right), measure **AC voltage** (~ V), at the distribution board's heater connector, between the: **Old heater:** BROWN and BLUE wires; **New heater:** BLACK and WHITE wires.

c) **IMPORTANT!** ASSURING Temperature is **LESS THAN 40° C** is the measurement greater than 90 volts AC?

Yes See procedure number T- 4.2.0 (page 115).

No NTC# 2 is bad (see Figure 6, page 13).

T- 4.2.0 CHECK POWER LOGIC BOARD

CAUTION! DC Voltages will be measured at pins that are close together and 'shorting' them with a regular meter probe may damage several boards. It is HIGHLY RECOMMENDED the Fluke TP 80 meter probe (or equivalent), together with the protective cap (see Figure 5, page 11) is used!

a) Referring Figure 50 (page 115), at the top of the power logic board is the 20-pin 'X2' connector. The solder (rear) side pins are arranged in two rows. Even numbered (2, 4, 6, etc) pins are in the top row, odd numbered (1, 3, 5, etc) in the bottom.

b) **Using TP 80**, measure DC voltage at the solder (rear) side of the 'X2' connector, *pin 6* (top row, 3 pins from rear of machine). Proceed accordingly:

- **Greater than 9.6 Volts:** The power logic board is bad (see Figure 4A and NOTE B, page 8).
- **Less than 3.6 Volts:** See procedure number T- 4.3.0 (page 115).

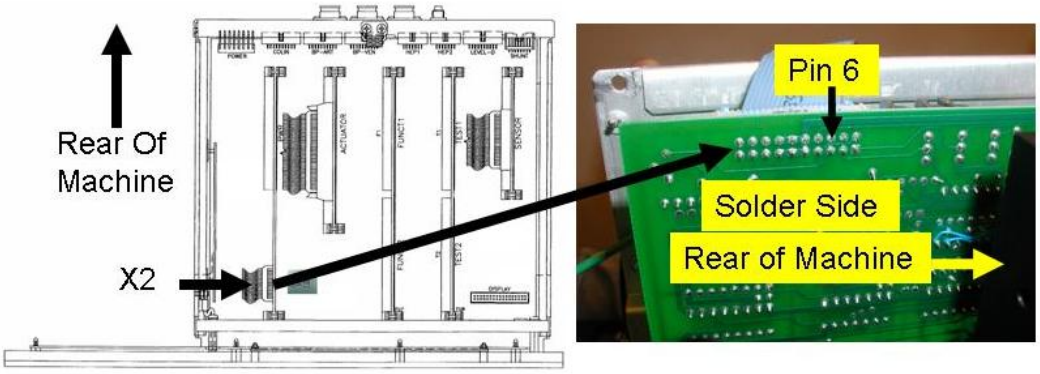
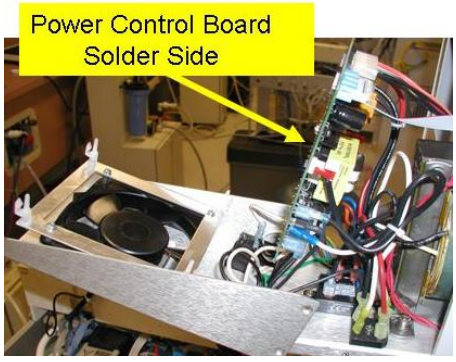


Figure 50 – Card Cage /Power Logic Board (Pin 6)

T- 4.3.0 CHECK FOR A 'SHORTED' TRIAC



a) Turn the machine off and **UNPLUG** it. **CAUTION! Electrocution hazard if not unplugged!**

b) Slide the power supply away from the cabinet. Un-mount the **power control board** from its four plastic clips.

c) Referring to Figure (right), remove the two **front** screws and lay the power supply's panel down to access to the rear (solder) side of the board.

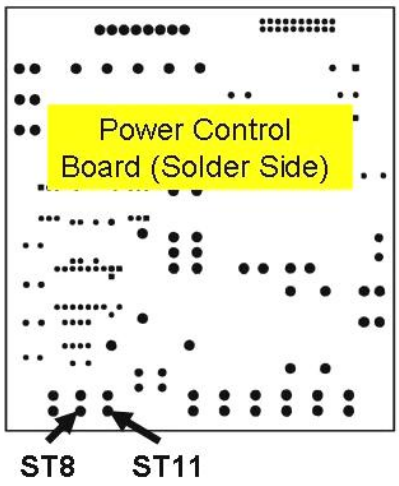
d) Referring to Figure 51 (page 116), measure resistance (Ω) at the solder (back) side of the board BETWEEN connectors ST 8 and ST 11. **Do NOT use TP 80!**

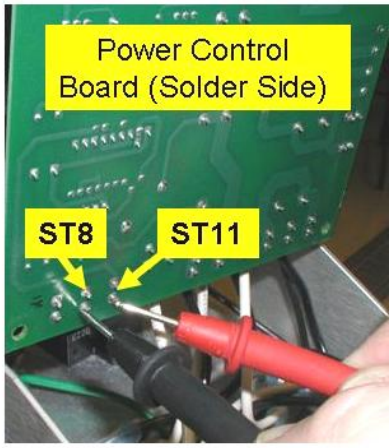
e) Is the meter's numeric AND units display indicating greater than 3 Million ohms (i.e. 3 **MΩ** (**NOTE!** "OL" is MUCH greater than 3 MΩ)?

Yes See procedure number T- 4.4.0 (page 116).

No a) Return NTC #2 to distribution board position "CON-NTC" (**1st** position from the left).

b) The triac is bad. See Figure 51 (page 116) OR trace the brown and blue wires connected to ST 8 and ST 11 to it. **IMPORTANT!** The triac's colored wires are position sensitive!





TRIAC

Wire Color	Connector
Orange	ST9
Brown	ST8
Blue	ST11

Figure 51 – Solder Side Power Control Board / Triac Wiring

T- 4.4.0 CHECK TEMP DISPLAY CALIBRATION

NOTE: The 'Temp Comp' option (Service Mode → Options → Hardware Options) must be turned off (i.e. "No" = blue) to perform this procedure otherwise the required [TEMP DAC] data box will not be available. 'Temp Comp', if required, can be reactivated when troubleshooting is complete.

a) Place the machine into Service Mode → Calibrate Sensors → Temperature Control.

b) Select the screen's [TEMP DAC] data box. It turns bright yellow. K^2 machines **ONLY** pressing the 'CONFIRM' key twice activates [TEMP DAC].

c) **NOTE** the current value in the [TEMP DAC] window.

d) Set the [TEMP DAC] data box to "20" then press the 'CONFIRM' key (the window turns pale yellow). This should turn the heater off if the electronics are working properly.

e) **Do NOT use TP80 for the subsequent AC voltage measurement!**

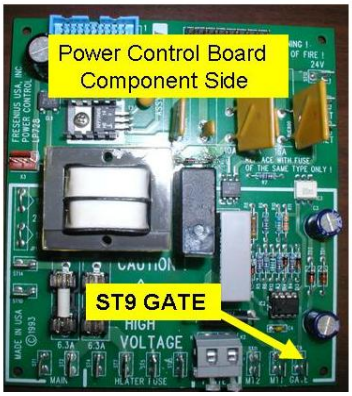
f) **IMPORTANT!** Allow the screen's [Monitor Reference] data box drop to 40° C or less.

g) With [Monitor Reference] less than 40° C, measure **AC voltage** (~ V) at the distribution board's heater connector between the: **Old style heaters**: BROWN and BLUE wires; **New style heaters:** BLACK and WHITE wires. Is the measurement greater than 90 volts AC?

Yes See procedure number T- 4.5.0 (page 117).

No The Temperature calibration is WAY out. Set the [TEMP DAC] window to 50 less than what was noted above. Press the 'CONFIRM' key twice to save the calibration then see procedure number T- 7.0.0 (page 121).

T- 4.5.0 CHECK TRIAC/POWER CONTROL BOARD



a) **Electrocution Hazard!** Turn the machine off and **UNPLUG** it.

b) Referring to the Figure (right), unplug the triac's orange wire from the **power control board's** GATE connector ST 9.

c) To avoid **damage** wrap black tape **around** the triac's **female** (orange-wired) connector.

d) Place the machine into Dialysis program (remember to press the 'CONFIRM' key). **CAUTION! High Voltage Now Present!**

e) From the Home screen, allow Temperature to fall to 40° C or less.

f) With Temperature 40° C or less, measure **AC voltage** (~ V) again at the distribution board's heater connector, between the: **Old style heaters**: BROWN and BLUE wires; **New style heaters:** BLACK and WHITE wires. Is the voltage measurement greater than 90 volts AC?

Yes a) **Electrocution Hazard!** Turn the machine off and **UNPLUG** it.

b) The triac is bad. See Figure 51 (page 116) OR trace the orange wire connected to ST9 to it. **CAUTION! The triac's colored wires are position sensitive!**

No a) **Electrocution Hazard!** Turn the machine off and UNPLUG it.

b) The **power control board** (inside the power supply) is bad. After replacement see procedure number T- 7.0.0 (page 121).

T- 4.7.0 CHECK NTC #2 (TEMP CONTROL) ELECTRICAL CONNECTIONS

a) **IMPORTANT!** Turn the machine off.

b) Open the card cage and place a meter lead on chassis ground (see Figure 1, page 3).

c) Place the **274 Ω** resistor plug, from the two-resistor OLC set, into the **1st** distribution board position from the left (labeled "CON-NTC").

d) Referring to Figure 52 (page 117), measure resistance (Ω) at the solder (rear) side of sensor board's X2 connector *pin 13* (bottom row, 7 pins from the rear of machine). Is the meter's numeric AND units display indicating less than 300 **Ω**?

Yes See procedure number T- 8.0.0 (page 126).

No a) **ASSURE** the **274 Ω** resistor plug is placed correctly and that you are making good contact with pin 13 before continuing!

b) **NOTE** that one (1) **NTC #2** connection will be checked and proceed to page 228, SECTION 17- CHECKING THE SENSOR BOARD CABLE. If the sensor cable checks good the distribution board may be bad.

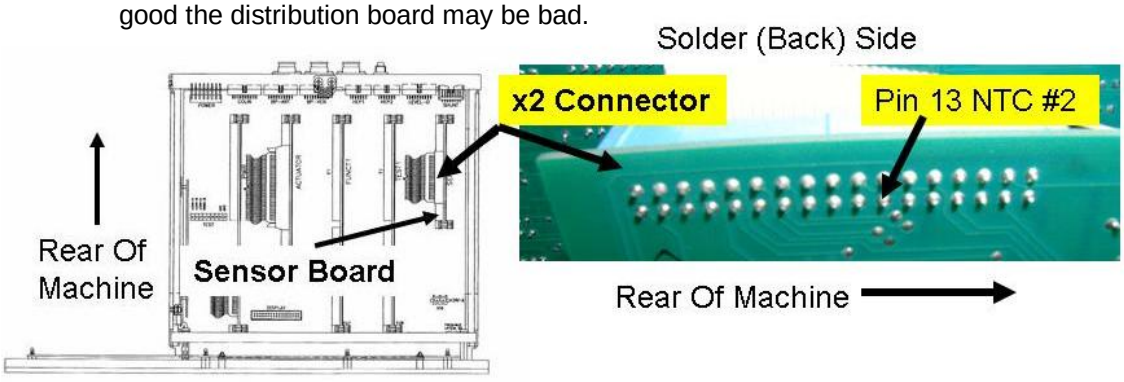
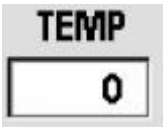


Figure 52 – NTC #2 Checks

T- 5.0.0 CHECK TEMP (SCREEN 4)

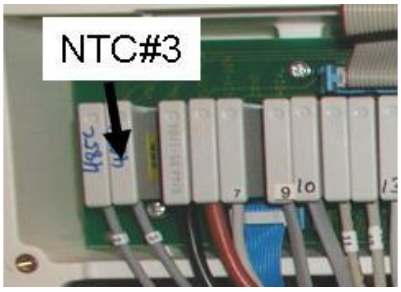


Call debug screen 4. Is **TEMP** = less than 0.5?

Yes See procedure number T- 5.0.1 (page 118).

No See procedure number T- 5.0.2 (page 144).

T- 5.0.1 CHECK NTC #3 POSITION RESISTANCE



a) **IMPORTANT!** Turn the machine off.

b) Open the card cage and place a meter lead on chassis ground (see Figure 1, page 3).

c) Referring to the Figure (right), place the **274 Ω** resistor plug, from the two-resistor OLC set, into the **2nd** distribution board position from the left (labeled "MON-NTC"). **ASSURE the resistor plug is placed correctly before continuing!**

d) Touch the ohm (Ω) meter's leads together and subtract this resistance reading from subsequent resistance (Ω) readings!

e) Referring to Figure 53 (page 118), CAREFULLY measure resistance at the solder (rear) side of sensor board's X2 connector *pin 12* (top row, 6 pins from rear of machine). Is the meter's numeric AND units display indicating less than 300 **Ω**?

Yes a) Return the **6.04 KΩ** resistor plug, from the two-resistor OLC set, into the **2nd** distribution board position from the left (labeled "MON-NTC"). **ASSURE the resistor plug is placed correctly before continuing!**

b) Return to Dialysis program (remember to press the 'CONFIRM' key) then see procedure number T- 5.0.2 (page 144).

No a) **ASSURE** the **274 Ω** resistor is placed correctly and that you are making good contact with pin 12 before continuing!

b) **NOTE** that **NTC #3's** connection will be checked and proceed to page 228, SECTION 17 - CHECKING THE SENSOR BOARD CABLE. If the sensor cable checks okay the distribution board may be bad.

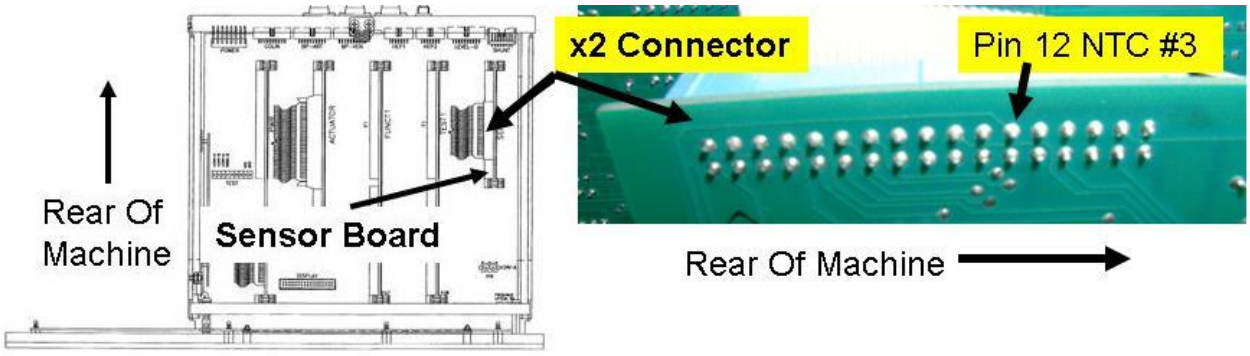


Figure 53 – NTC #3 Checks

T- 5.0.2 CHECK DEBUG VALUES

From debug screen 4, note **TEMP** and **ATEM** (respectively NTC #3 voltages from the sensor and actuator boards). Referring to Table 17 (page 119), proceed accordingly:

Table 17 – Debug Screen 4 TEMP Values

TEMP (Volts DC)	ATEM (Volts DC)	YOUR RESPONSE:
Greater than 5.5	Greater than 5.0	See procedure number T- 5.0.3 (page 119).
Greater than 5.5	Between 3.5 and 5.0	Bad sensor board (see Figure 4A, page 8).
Greater than 5.5	Less than 3.5	See procedure number T- 5.0.3 (page 119).
Between 4.5 and 5.5	Greater than 5.0	Bad actuator board (see Figure 4A, page 8).
Between 4.5 and 5.5	Between 3.5 and 5.0	See procedure number T- 7.0.0 (page 121).
Between 4.5 and 5.5	Less than 3.5	Bad actuator board (see Figure 4A, page 8).
Less than 4.5	Greater than 5.0	See procedure number T- 5.0.3 (page 119).
Less than 4.5	Between 3.5 and 5.0	Bad sensor board (see Figure 4A, page 8).
Less than 4.5	Less than 3.5	See procedure number T- 5.0.3 (page 119).

T- 5.0.3 TROUBLESHOOT TEMPERATURE DISPLAY

Six possibilities (see Figure 4A, page 8); 1) Bad test board; 2) Bad actuator board; 3) Bad power logic board; 4) Bad sensor board; 5) Bad distribution board; 6) Bad motherboard.

T- 6.0.0 VERIFY HEATER / INCOMING WATER TEMPERATURE

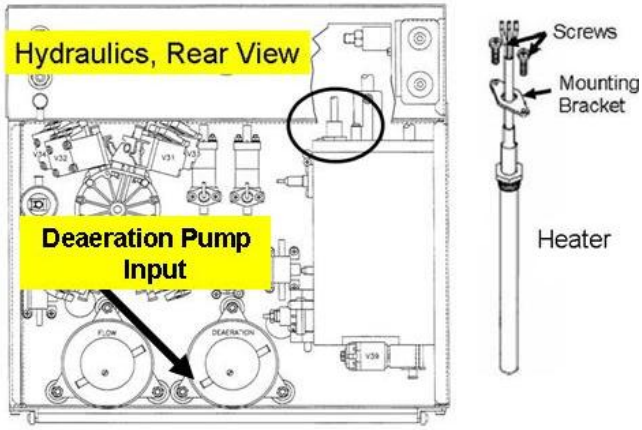
a) ASSURE incoming water temperature is remaining between 10° and 25° C (50° and 77° F)

b) **IMPORTANT!** Turn the machine off.

c) Referring to the Figure (right) rotate the heater 180°. **Tighten the bracket screws evenly!** The heater **MUST** be perfectly vertical to maintain proper flow geometry.

d) Connect to concentrate and place the machine into Dialysis program (remember to press the 'CONFIRM' key).

e) From the Home screen allow ten minutes then watch **Temperature**. If still unstable see procedure number T- 6.1.0 (page 119).



T- 6.1.0 CHECK AIR REMOVAL SYSTEM

a) Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks) and allow one minute for the deaeration pump to stop.

b) Referring to the Figure (above, right), tee a gauge to the input of the deaeration pump.

c) **IMPORTANT!** Turn Dialysate flow ON (Dialysate Flow on/off LED off). Referring to Appendix A (page 260), is Deaeration pressure okay?

Yes See procedure number T- 6.2.0 (page 120).

No See procedure number T- 6.1.1 (page 120).

T- 6.1.1 CALIBRATE DEAERATION PRESSURE

Calibrate Deaeration and Loading Pressure per procedure. Is the calibration successful?

Yes a) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

b) Allow eight minutes From the Home screen if Temperature is still unstable see procedure number T- 6.2.0 (page 120).

No Proceed to page 211, SECTION 13 - DEAERATION PROBLEMS.

T- 6.2.0 CHECK FLOW STABILITY (BC SWITCH)

a) Call debug screen 1. If (and ONLY if) **NPHT** is less than 300 press and hold the "1" numeric until **NPHT** is greater than 600. **Ignore an "On Line PHT Fail" message**.

b) Call Home screen. **NOTE** the selected dialysate flow rate. Assure it is NOT set to "a300", "a500" or "a800". **IMPORTANT!** If Dialysate flow rate is or was changed allow three minutes for stabilization. **If Flow is manually changed remember to press the 'CONFIRM' key.**

c) From debug screen 1, ASSURE **FILACT** = 0 constant! If **FILACT** = 1 an air leak is present indicating a hydraulic air leak which may cause unstable Temperature!

d) **IMPORTANT!** Do NOT reset alarms!

e) Call debug screen 6 and CAREFULLY watch **BC Switch** for one minute. Referring to Table W (page 120), is it remaining between the indicated times for the NOTED **selected flow rate**?

Yes See procedure number T- 6.3.0 (page 120).

No a) Call the Home screen and check the selected flow rate. It may have defaulted to a different rate other than what was noted above (idle flow option). If (and ONLY if) flow rate has changed repeat procedure number T- 6.2.0 (page 120).

b) Proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM.

Table W

If NOTED selected Dialysate Flow rate is	BC Switch between:
300 ml/min	540 and 660 (5.40 – 6.60 seconds)
500 ml/min	324 and 396 (3.24 – 3.96 seconds)
800 ml/min	203 and 248 (2.03 – 2.48 seconds)

T- 6.3.0 ON-LINE PRESSURE HOLDING TESTS (BALANCING CHAMBER VALVES)

Call debug screen 1. Is **NPHT** (upper right) remaining = 720?

Yes On Line PHT is not activated. Enter Service Mode → Options → Hardware Options. Set ONLINE PHT to "yes". Press the 'CONFIRM' key ("yes" = blue). Return to Dialysis program and repeat procedure number to T- 6.3.0.

No a) Press and hold numeric key pad #1 key for 5 seconds or until **PHTACT** = 1 (test active).

b) When **PHTACT** = 0 repeat the test by holding numeric keypad #1 until **PHTACT** = 1.

c) When **PHTACT** = 0, from screen 1, check **PHT0** and **PHT1**. Are both less than 25?

Yes **NOTE** the page and procedure number in case you need to return here:

a) Proceed to page 238, SECTION 19 - TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM

b) If a balancing chamber diaphragm leak is NOT located see procedure number T- 7.0.0 (page 121).

No Proceed to page 190, SECTION 10 – PRESSURE TESTS FAILING.

T- 7.0.0 CHECK TEMPERATURE SENSOR

WARNING! Before entering Service Mode it is critical that the machine is NOT issuing a "No Water" alarm, loading pressure is good, and the machine is TOTALLY free Flow Errors (debug screen 1, Flow Error = 0 (constant). Alarm banners do NOT occur in Service mode!

This is NOT a routine Temperature Sensor Calibration! Follow these procedures carefully to avoid error!

a) Enter Service Mode → Calibrate Sensors → Temp Sensors. **IMPORTANT!** Two checks while performing this calibration. Read both then proceed with the Temp Sensors calibration:

1. The [Pre-Temperature Reference] data box value should increase with each resistor plug per Table 18 (page 121) if (and ONLY if) the CORRECT resistor plug is used **AND** the Temperature monitoring circuit is working properly otherwise an "Operator Error" message occurs.
2. After installing each resistor plug and **BEFORE** pressing the 'CONFIRM' key, the [Pre-Temperature Reference] data box value should NOT vary more than +/- 2.

Table 18 - Pre Temperature Reference Values

First Resistor: 34° C = 6.808 KΩ Pre-Temperature Reference value = 70 +/- 6	**Third Resistor:** 80° C = 1.255 KΩ Pre-Temperature Reference value = 197 +/- 6
Second Resistor: 41° C = 5.117 KΩ Pre-Temperature Reference value = 163 +/- 6	**Fourth Resistor:** 90° C = 0.915 KΩ Pre-Temperature Reference value = 210 +/- 6

b) Were both of the above checks for all four resistor plugs okay?

Yes Press the 'CONFIRM' key twice to save the calibration then see procedure number T- 7.0.2 (page 122).

No **NOTE** which checks were not okay then see procedure number T- 7.0.1 (page 121).

T- 7.0.1 TROUBLESHOOT TEMPERATURE SENSOR

a) Turn the machine off and back on. **IMPORTANT!** Two checks while CAREFULLY repeating the TEMP SENSORS calibration:

1. **ASSURE** the CORRECT resistor plugs are installed at distribution board position labeled "MON-NTC" (**2nd position from the left**) AND in the CORRECT order as prompted on the screen (see also Table 18, page 121).
2. **ASSURE** that the 'CONFIRM' key was pressed before placing the next resistor plug.

b) Did the **NOTED** problem(s) reoccur when repeating the calibration?

Yes See procedure number T- 7.1.1 (page 125).

No See procedure number T- 7.0.2 (page 122).

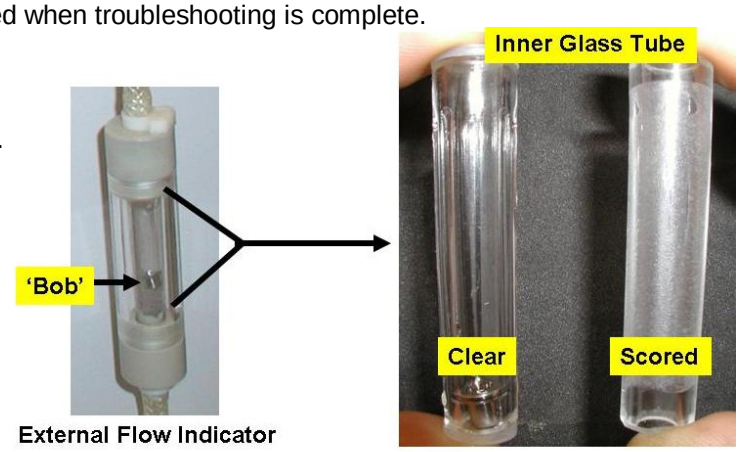
T- 7.0.2 TEMPERATURE CONTROL CHECKS

IMPORTANT NOTE! This is NOT a routine Temperature Control Calibration! Follow these procedures carefully to avoid error! Be PATIENT! It may take a while to achieve good Temperature especially if the Temperature calibration is out of specification!

IMPORTANT NOTE! The 'Temp Comp' Option (Options → Hardware Options) must be turned OFF (i.e. "No = blue) to perform these procedures otherwise the required [TEMP DAC] data box is not available. TEMP COMP (if turned on) can be reactivated when troubleshooting is complete.

a) Referring to the Figure (right), check the external flow indicator's (#75) **inner** tube for scoring (i.e. the tube appears cloudy). Scoring may restrict the 'bob's' movement. Normally the tube is **very clear**. If (and ONLY if) scoring is located repair the indicator **BEFORE** performing these procedures.

b) If the external flow indicator is clear, **IMPORTANT!** ASSURE (three checks):



External Flow Indicator

1. ASSURE the HEATER switch, at the rear of the machine, is ON (pressed in towards "1" or "ON").
2. ASSURE the female connector labeled #2 is plugged into the **1st** distribution board position from the left (labeled "CON-NTC").
3. ASSURE the female connector labeled #3 is plugged into **2nd** distribution board position from the left (labeled "MON-NTC").

c) **IMPORTANT!** Plug the concentrate connector(s) into concentrate

d) Place both rear panels over the hydraulics however there is no need to screw them in.

e) From Service Mode, select Calibrate Sensors → Temp Control. Follow the screen's instructions to step #5, "Adjust the Temp DAC …." **Do NOT adjust the Temp DAC until instructed!**

f) **IMPORTANT!** Assure the shunt door is closed!

g) **Without** adjusting the screen's [TEMP DAC] data box CAREFULLY watch the screen's [Monitor Reference] data box AND the external flow indicator's 'bob' for eight minutes. Two checks:

1. If [Monitor Reference] exceeds 41° C at some point.
2. If the flow indicator's 'bob' remains **DOWN** for greater than 5 seconds at any time.

h) Proceed accordingly (three scenarios):

1. **[Monitor Reference] exceed 41° C or greater at some point:** See procedure number T- 7.0.3 (page 123).
2. **[Monitor Reference] NEVER exceeds 41° C but the external flow indicator remained or remains down for longer than 5 seconds at some point:** See procedure number T- 7.0.4 (page 123).
3. **[Monitor Reference] NEVER exceeds 41° C AND the external flow indicator NEVER stops moving up and down:** See procedure number T- 7.0.5 (page 123).

T- 7.0.3 TROUBLESHOOT 'NO FLOW' THROUGH FLOW INDICATOR

a) Activate the [TEMP DAC] data box (it turns bright yellow) and set its value to "20". This should turn the heater off. K^2 machines **ONLY** pressing the 'CONFIRM' key twice activates [TEMP DAC].

b) Press the 'CONFIRM' key (the data box turns pale yellow). **IMPORTANT NOTE! If the data box turns gray the 'CONFIRM' key was accidently pressed twice. In this event, press the 'Escape' key then return to Calibrate Sensors → Temp Control through step #5 then repeat procedure number T- 7.0.3.**

c) Allow twelve minutes. Does the [Monitor Reference] data box decrease to and remain 38° C or lower?

Yes See procedure number T- 7.0.4 (page 123).

No See procedure number T- 7.1.3 (page 125).

T- 7.0.4 CHECK DIALYSIS PROGRAM ALARMS / ADJUST TEMP DAC AND MONITOR REFERENCE

a) Turn the machine off, back on and return to Dialysis Program (remember to press the 'CONFIRM' key).

b) If (and ONLY if) a "No Water" message appears on the screen, proceed to **page 64**, SECTION 2 – NO WATER.

c) Call debug screen 0 and watch **Flow Error** for two minutes If (and ONLY if) **Flow Error** = 1 (constant or intermittent) proceed to page 14**,** SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM

d) Place the machine into Service Mode → Calibrate Sensors → Temp Control

e) Activate the [TEMP DAC] data box (it turns bright yellow) and decrease it by 40. Example: if [TEMP DAC] = 145 set it to 105. K^2 machines **ONLY** pressing the 'CONFIRM' key twice activates [TEMP DAC].

f) Press the 'CONFIRM' key twice to activate the screen's [Monitor Reference] data box (it turns bright yellow).

g) Set [Monitor Reference] as low as it will go then press the 'CONFIRM' key twice to save the calibration.

h) Return to procedure number T- 7.0.2 (page 122) **and proceed from part d**.

T- 7.0.5 CHECK TEMPERATURE INCREASE

a) During these remaining procedures, keep a watchful eye on the external flow indicator. If (and ONLY if) the 'bob' EVER STOPS moving up for longer than 5 seconds press the 'Escape' key then return to procedure number T- 7.0.2 (page 122) and proceed from part d. For now continue to step b.

b) From the external meter's reading, proceed accordingly (three scenarios):

1) Increases to (but does not remain) 41° C or greater: Return to Dialysis program (remember to press the 'CONFIRM' key) then see procedure number T- 4.0.0 (page 114).

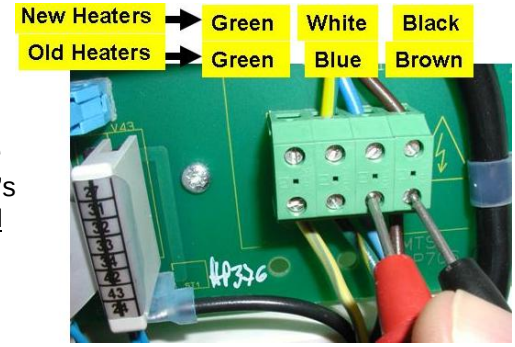
2) Remains less than 35° C: See procedure number T- 7.0.6 (page 124).

3) Remains greater than 35° C but NEVER exceeds 41° C: See procedure number T- 7.0.7 (page 124).

T- 7.0.6 CHECK HEATER VOLTAGE

a) Unplug the connector from the **1st** distribution board position from the left (labeled "CON-NTC"). This is NTC #2.

b) **CAUTION! 120 Volts AC possible!** Referring to the Figure (right), measure **AC voltage** (~ V), at the distribution board's heater connector, between the: **Old style heaters**: BROWN and BLUE wires; **New style heaters:** BLACK and WHITE wires.



c) Proceed accordingly based on the measurement (two scenarios):

1) Greater than 90 volts: CAREFULLY return NTC#2 to distribution board position "CON-NTC" (**1st** position from the left) then see procedure number T- 7.0.7 (page 124).

2) Less than 10 volts: If CERTAIN the meter is set to **AC voltage** (~ V) AND the HEATER switch is ON, AND measuring correctly then see procedure number T- 2.0.0 (page 104).

T- 7.0.7 TEMPERATURE CONTROL (PART#1, TEMP CONTROL, NTC #2)

There are two parts to the Temperature Control Calibration. Part #1 = Set 'Actual' Temperature to 37° C (NTC #2 controlled); Part #2 = Set 'Displayed' Temperature to 37° C (NTC #3). **ASSURING the external flow indicator's 'bob' is continually moving up and down:**

a) If meter Temperature is not 37.0 +/- 0.1°, activate the [TEMP DAC] data box. It turns bright yellow and its value can now be adjusted. K^2 machines **ONLY** pressing the 'CONFIRM' key twice activates [TEMP DAC].

NOTE: Adjusting the [TEMP DAC] value by +/- 2 units increases/decreases Temperature by approximately +/- 0.1 ° C.

b) After adjustment, press the 'CONFIRM' key. The [TEMP DAC] data box should turn pale yellow. **IMPORTANT NOTE! If the data box turns gray before meter Temperature = 37.0 +/- 0.1° C the 'CONFIRM' key was accidently pressed twice. In this event, press the 'Escape' key then return to Calibrate Sensors → Temp Control through step #5 and repeat procedure number T- 7.0.7.**

c) **IMPORTANT!** If a [TEMP DAC] adjustment was made, allow 8 full minutes for Temperature to stabilize. Repeat parts a through c until the external meter stabilizes to 37.0 +/- 0.1° C. Are you able to achieve stable Temperature on the external meter?

Yes See procedure number T- 7.0.8 (page 124).

NOTE: If the [TEMP DAC] value has to be set above 180 or below 110 to achieve 37°C this may indicate a bad NTC #2 or a bad sensor board. If the Temperature problem reoccurs in Dialysis Program consider this.

No Proceed accordingly (three scenarios):

1. **NTC #2 was already checked in THIS troubleshooting session:** Replace NTC #2 (see Figure 42, page 94) with a known good then return to procedure number T- 7.0.2 (page 122).
2. **NTC #2 was replaced in THIS troubleshooting session:** Was step T- 6.0.0 (page 119) performed in this troubleshooting session?

   Yes Six possibilities: 1) Bad heater (see Figure 6, page 13); 2) Bad float switch #5 (see Figure 28, page 59); 3) Bad sensor board; 4) Bad function board; 5) Bad distribution board.

   No See procedure number T- 6.0.0 (page 119).
3. **NTC#2 was NEITHER replaced NOR checked in THIS troubleshooting session:** See procedure number T- 8.0.0 (page 126) to check (or replace) NTC #2.

T- 7.0.8 CHECK NTC #3 STABILITY

CAREFULLY watch the [Monitor Reference] data box for one minute. **NOTE its value does NOT matter at this time!** Is it remaining stable (i.e. does not vary more than +/- 0.15° C)?

Yes See procedure number T- 7.0.9 (page 125).

No Replace NTC #3 (see Figure 42, page 94) then return to procedure number T- 7.0.2 (page 122).

T- 7.0.9 MONITOR REFERENCE (PART 2, TEMP DISPLAY, NTC #3)

a) Press the 'CONFIRM' key to activate the [Monitor Reference] data box (it turns yellow).

b) Are you able to set [Monitor Reference] to match the external meter's reading (i.e. 37.0 +/- 0.1° C)?

Yes See procedure number T- 7.1.0 (page 125).

No Two possibilities: 1) Bad NTC #3 (see Figure 42, page 94); 2) Bad function board.

T- 7.1.0 TEMPERATURE CHECKS

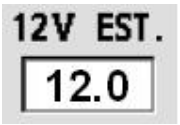
a) Press the 'CONFIRM' key twice to save the calibration. The data box turns gray.

b) **IMPORTANT!** Assure the [Monitor Reference] data box continues to read 37 +/- 0.1° C after pressing the 'CONFIRM' key. If (and ONLY if) it DOES NOT two possibilities: 1) Bad NTC#3; 2) Bad function board.

c) Place the machine into Dialysis Program (remember to press the 'CONFIRM' key).

d) Allow **eight minutes** for stabilization then call the Home screen. If Temperature does NOT remain stable (+/- 0.15 ° C) ASSURE the heater bracket screws have been tightened evenly. Try rotating it (per procedure number T- 6.0.0 , page 119). Two other possibilities: 1) Bad NTC #3 (see Figure 42, page 94); 2) Bad float switch #5 (see Figure 28, page 59).

T- 7.1.1 CHECK +12 VOLT STABILITY



Call debug screen 1 and watch **12V EST** for **one minute**. Is it remaining between 11.7 and 12.3 volts AND stable (does not vary greater than +/- 0.1)?

Yes See procedure number T- 7.3.0 (page 126).

No See procedure number T- 7.1.2 (page 125).

T- 7.1.2 TROUBLESHOOT POWER SUPPLY INSTABILITY

Turn the machine off and swap in a known good **new style power logic board** (assure the 'Convertor' board is NOT present) OR an **old style power logic board** AND a known good 'Convertor' board [1, 2]

[1] **CAUTION! To avoid damage, the 'Convertor' board MUST be installed with the 'solder side' towards the front of the machine AND matched exactly pin for pin to the TEST connector**.

[2] If the problem still exists (bad or unstable +12 volts) after replacement proceed to **page** Error! Bookmark not defined., SECTION 24 – TROUBLESHOOTING POWER DISTRIBUTION.

T- 7.1.3 TROUBLESHOOT HIGH TEMPERATURE

a) At the rear of the machine, turn the HEATER switch off (rocker switch pressed into "0" or "OFF").

b) Allow up to 15 minutes. Does the [Monitor Reference] data box drop to and remain 34° C or less?

Yes There is a problem that was not caught earlier.

a) Turn the HEATER switch "ON".

b) Return to procedure number T- 1.0.5 (page 94)

No **Read this entire procedure before performing it!**

a) Turn the machine off and replace NTC #3 (see Figure 42, page 94).

b) Turn the Heater switch ON and place the machine into Dialysis program (remember to press the 'CONFIRM' key).

c) Return to procedure number T- 7.0.2 (page 122) however if the procedures return here see procedure number T- 7.3.0 (page 126).

T- 7.3.0 TROUBLESHOOT TEMP DISPLAY PROBLEM

Seven possibilities: 1) Bad test board; 2) Bad actuator board; 3) Bad sensor cable*; 4) Bad sensor board; 5) Bad function board; 6) Bad distribution board; 7) Bad motherboard.

***** The cable can be checked for continuity. **NOTE** that one (1) **NTC #3** connection will be checked and proceed to page 228, SECTION 17 - CHECKING THE SENSOR BOARD CABLE.

T- 8.0.0 CHECK NTC #2

This procedure checks NTC #2 resistance (Ω). An accurate thermometer is required. If not available or, if preferable, replace NTC #2 (see Figure 54, page 126) with a **known good** then return to procedure number T- 7.0.2 (page 122).

a) **IMPORTANT!** Turn the machine off.

b) Referring to Figure 54 (page 126), unplug the connector from the **1st** position from the left, (labeled "CON-NTC"). This is NTC #2.

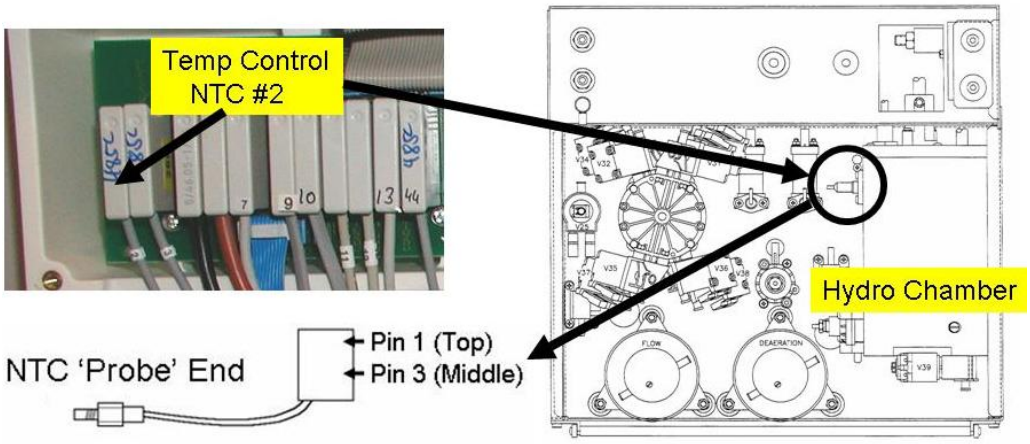
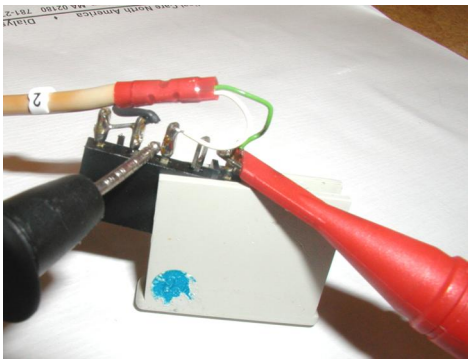


Figure 54 – Hydraulics Rear View – NTC #2

c) Using a flashlight, check the vacant position for 'white' corrosion or damaged **male** pins that may cause false signals**. If damage is located this may be the problem!**



d) Referring to Figure 54, remove NTC #2 from the hydro chamber to expose its 'probe end'.

e) Clean the 'probe end' with paper towel. **Do not touch it from this point forward to avoid fouling it!**

f) **VERY CAREFULLY** (**very thin wires**) open NTC #2's female distribution board connector.

g) Check for rust, corrosion, or broken solder connections. Replace the NTC if rust or corrosion is located.

h) Touch your ohm meter's leads together and subtract its resistance (Ω) reading from subsequent resistance readings.

i) Referring to the Figure (above, right), CLIP or **HOLD FIRMLY** the meter leads between the green and white wires.

j) Fill a Styrofoam cup with water between 36 and 38° C as measured with an **accurate industrial grade** thermometer.

k) Referring to the Figure (right),drop NTC 2's probe end into the cup and **allow 30 seconds for stabilization**.

l) Referring to Table 19 (page 127), is NTC #2 resistance (meter's numeric AND units display) indicating a resistance of between the minimum and maximum (**KΩ**) range?

Yes Return to procedure number T- 7.0.2 (page 122) and proceed from part d.

No Replace NTC#2 (see Figure 54, page 126) with a **known good** then return to procedure number T- 7.0.2 (page 122).

Table 19 – NTC RESISTANCE

Temperature (°C)	Minimum Resistance	Nominal Resistance	Maximum Resistance
36.0	6.142 KΩ	6.267 KΩ	6.392 KΩ
36.1	6.117 KΩ	6.242 KΩ	6.367 KΩ
36.2	6.092 KΩ	6.217 KΩ	6.342 KΩ
36.3	6.067 KΩ	6.192 KΩ	6.317 KΩ
36.4	6.042 KΩ	6.167 KΩ	6.292 KΩ
36.5	6.017 KΩ	6.142 KΩ	6.267 KΩ
36.6	5.992 KΩ	6.117 KΩ	6.242 KΩ
36.7	5.967 KΩ	6.092 KΩ	6.217 KΩ
36.8	5.942 KΩ	6.067 KΩ	6.192 KΩ
36.9	5.917 KΩ	6.042 KΩ	6.167 KΩ
37.0	5.892 KΩ	6.017 KΩ	6.142 KΩ
37.1	5.868 KΩ	5.993 KΩ	6.118 KΩ
37.2	5.844 KΩ	5.969 KΩ	6.094 KΩ
37.3	5.820 KΩ	5.945 KΩ	6.070 KΩ
37.4	5.796 KΩ	5.921 KΩ	6.046 KΩ
37.5	5.772 KΩ	5.897 KΩ	6.022 KΩ
37.6	5.748 KΩ	5.873 KΩ	5.998 KΩ
37.7	5.724 KΩ	5.849 KΩ	5.974 KΩ
37.8	5.700 KΩ	5.825 KΩ	5.950 KΩ
37.9	5.676 KΩ	5.801 KΩ	5.926 KΩ
38.0	5.652 KΩ	5.777 KΩ	5.902 KΩ

SECTION 5 - CONDUCTIVITY / ON LINE CLEARANCE PROBLEMS

These procedures troubleshoot Conductivity problems and for stability factors which may cause On-Line Clearance (OLC) problems.

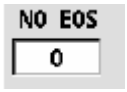
A) If multiple machines are exhibiting similar symptoms:

- Check the specific gravity and/or conductivity of the concentrate batches. Un-dissolved granules powder in the bottom of the jug or tank indicates inadequate mixing or too much dry mix
- If used, check the central delivery (SDS) system(s) for proper delivery

B) **Conductivity does NOT change instantaneously. Observe all stated times to avoid error and possible machine damage.**

C) **IMPORTANT!** If Automated Tests start (screen reads "Test …") allow them to complete! Automated Testing, while troubleshooting, may cause misdiagnosis! IGNORE all test fail messages for now**!**

D) Remove the venous 'dummy chamber' from the Level Detector module to prevent Forced Test.

E) Call debug screen 1. Watch **NO EOS** 

AND **ALWEOS**

for **one minute**. Proceed according to Table 20 (page 128).

Table 20 - EOS Values

NO EOS	ALWEOS	YOUR RESPONSE
0	0	See procedure number CO 1.0.0 (page 128).
1	0	Proceed to page 161, SECTION 6 - CONCENTRATE PUMP ERRORS.
0	1	Proceed to page **161**, SECTION 6 - CONCENTRATE PUMP ERRORS.

CO- 1.0.0 CHECK FLOW ERROR

Flow Errors cause erratic concentrate pump delivery:

a) ASSURE the machine has been running in Dialysis Program, connected to FRESH concentrate, with Dialysate flow ON (Dialysate Flow on/off LED off), for at least five minutes.

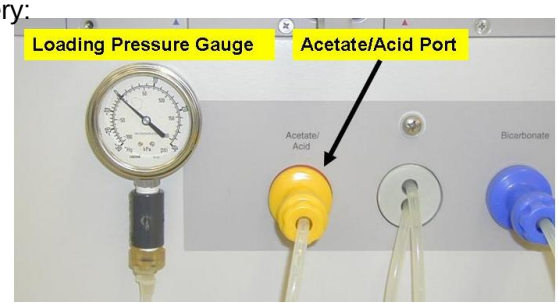
b) Open the shunt door and allow 45 seconds for flow transitions to occur.

c) Call debug screen 0. Watch **Flow Error** for one minute or until if **Flow Error** = 1. Proceed accordingly:

- **Flow Error = 1 (intermittent or constant):** Proceed to **page 14**, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM.
- **Flow Error = 0 constant:** See procedure number CO 1.0.1 (page 128).

CO- 1.0.1 CHECK LOADING PRESSURE

Bad loading pressure causes erratic concentrate pump delivery:



a) ASSURING that the loading pressure gauge (yellow connector) reads 0 psi before inserting it, **SLAM** it into the Acetate/Acid rinse port (see Figure right).

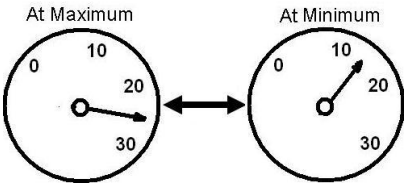
b) Per Table 21 (page 129), loading pressure MUST be **fluctuating** to its maximum **AND** NEVER dropping below the minimum. CAREFULLY watch BOTH levels for 90 seconds. Is loading pressure 'okay'?

Yes Close the shunt door and see procedure number CO- 1.0.2 (page 129).

No Proceed to **page 14**, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM.

Table 21 – Loading Pressure

DiaSafe® filter?	Maximum:	Minimum (no lower than):
Yes	23 – 25 psi	16 psi
No	18 – 20 psi	11 psi



CO- 1.0.2 ACETATE OR BICARBONATE SELECTED?

This procedure determines if **ACETATE** or **BICARBONATE** concentrate is selected:

- **ACETATE** is VERY rarely (if ever) used. Only one concentrate (a 1:34 ACETATE) is used and the bicarbonate (blue) concentrate connector is left in its rinse port**. It may have been selected accidently**.
- If **BICARBONATE** is selected BOTH the red and blue concentrate connectors are plugged into concentrate. **In MOST cases BICARBONATE is selected**:

a) Press the 'Escape' key to call the Home screen.

b) Select the 'Dialysate' tab, at the bottom of the screen, to call the 'CONFIRM Concentrate' screen (see Figure 55, page 129).

= Acetate

c) Is the screen's [Bicarbonate] window = 0?

Yes **Acetate** is selected! **NOTE** this and see procedure number CO- 1.0.3 (page 130).

No **Bicarbonate** is selected. **NOTE** this and see procedure number CO- 1.0.5 (page 130).

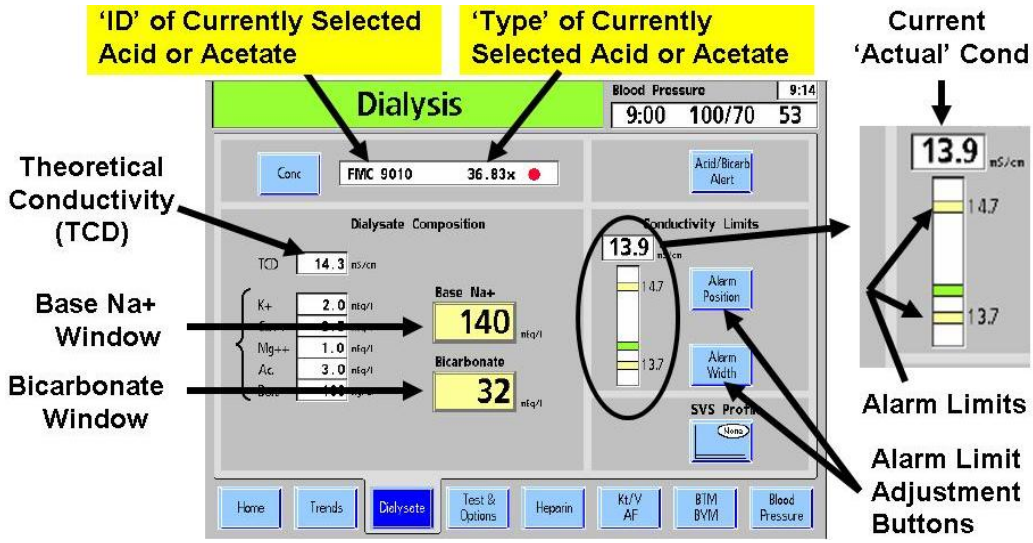


Figure 55 – CONFIRM Concentrate Screen

CO- 1.0.3 VERIFY ACETATE

Is Acetate supposed to be selected per Doctor's orders?

Yes See procedure number CO- 1.0.4 (page 130).

No
a) Attach to acid and FRESH bicarbonate.
b) Select the screen's 'Conc' button then select the ACID that is attached to the machine per its labeling.
c) Press the 'CONFIRM' key. Allow eight minutes. If Conductivity is still a problem repeat procedure number CO- 1.0.2 (page 129).

CO- 1.0.4 VERIFY CONDUCTIVITY PROBLEM (ACETATE ONLY)

a) Check the concentrate jug's labeling to ASSURE its 1:34 **Acetate** (i.e. it is NOT acid).

b) The bicarbonate (blue) connector should be in the rinse port.

c) From the Home screen, is **Conductivity** low?

Yes See procedure number CO- 1.0.6 (page 130).

No See procedure number CO- 1.0.8 (page 131).

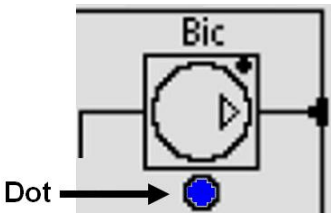
CO- 1.0.5 VERIFY CONDUCTIVITY PROBLEM (BICARBONATE ONLY)

a) **IMPORTANT!** ASSURE the BLUE concentrate connector is attached to FRESH[1] bicarbonate that has been ADEQUATELY MIXED[2].

b) ASSURE the RED concentrate connector is attached to acid that has been ADEQUATELY MIXED[2].

[1] Bicarbonate is good only for 24 hours! [2] Un-dissolved granules in the bottom of the jug or tank may indicate inadequate mixing or too much dry mix!

c) Call debug screen 0. What color is the BIC pumps dot (see Figure right)?



- **White:** See procedure number CO- 9.0.0 (page 152).
- **Blue:** From the Home screen, is **Conductivity** low?

  Yes See procedure number CO- 1.0.6 (page 130).

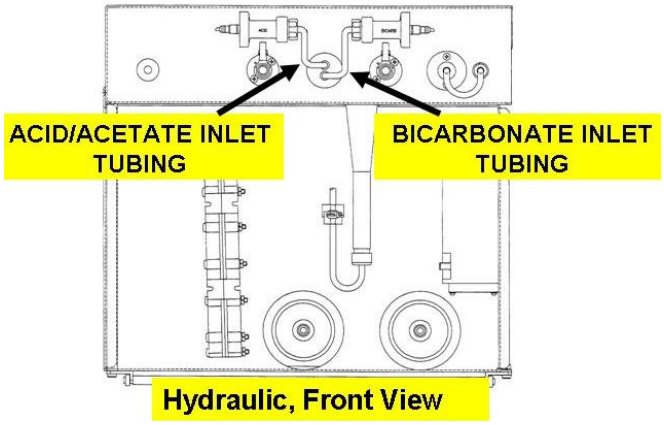
  No See procedure number CO- 1.0.8 (page 131).

CO- 1.0.6 LOW CONDUCTIVITY CHECK

Referring to the Figure (right), **without disconnecting from the concentrate source**, are excessive air bubbles seen though the acid/acetate and/or (if using bicarbonate) bicarbonate inlet tubing?

Yes See procedure number CO- 4.0.0 (page 139).

No See procedure number CO- 1.0.7 (page 131).



CO- 1.0.7 CHECK CONCENTATE INLET

Because air is easier to see than fluid, this procedure introduces a small air bolus to check the pump(s):

a) **MOMENTARILY** disconnect each concentrate connector from their source.

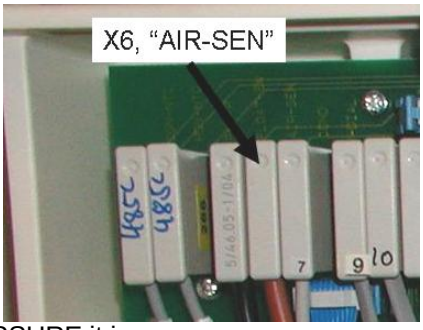
b) Through the acid/acetate and/or (if using bicarbonate) bicarbonate inlet tubing, is air drawn steadily in one direction only indicating the concentrate pump(s) are functioning properly?

Yes a) **IMPORTANT!** Reconnect to concentrate

b) From the Home screen, set Dialysate flow to 800 ml/min then see procedure number CO- 1.0.8 (page 131).

No See procedure number CO- 4.0.0 (page 139).

CO- 1.0.8 CHECK FLOW STABILITY

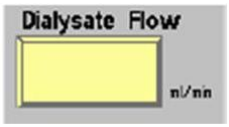


a) Open the shunt door and leave it open until instructed otherwise!

b) Referring to the Figure (right), place one of the resistor plugs, from the four-resistor Temperature set, into the air sensor's distribution board position labeled "AIR-SEN". **Leave the plug installed until instructed otherwise!**

c) Allow 30 seconds thsn call debug screen 1. If the resistor plug was placed correctly, **FILACT** = 0 constant.

d) From the Home screen, **NOTE** the **selected** Dialysate Flow rate. ASSURE it is NOT set to "a300", "a500" or "a800". **IMPORTANT!** If flow rate is or was changed allow three minutes for stabilization. If Flow is manually changed press remember to press the 'CONFIRM' key.



e) From debug screen 1, if **NPHT** is less than 600 press and hold the "1" numeric keypad until **NPHT** is greater than 600. **Ignore an "On Line PHT Failed" message if it occurs for now**.

f) **IMPORTANT!** Do NOT reset alarms!

g) Call debug screen 6 and CAREFULLY watch **BC Switch** (**B**alancing **C**hamber **S**witching **T**ime) for one minute. Referring to Table H (page 131) is it remaining between the indicated times for the **NOTED selected flow rate**?

Yes See procedure number CO- 1.0.9 (page 132).

No a) Call the Home screen and check the selected flow rate. It may have defaulted to a different rate other than what was noted (idle flow option). If (and only if) flow rate has changed repeat procedure number CO- 1.0.8 (page 131) from, part d.

b) Close the shunt door and proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM

Table H – BC Switch

If NOTED selected Dialysate Flow rate is	BC Switch:
300 ml/min	540 and 660 (5.40 and 6.60 seconds)
500 ml/min	324 and 396 (3.24 and 3.96 seconds)
800 ml/min	203 and 248 (2.03 and 2.48 seconds)

CO- 1.0.9 CHECK/SET TEMPERATURE

a) Press the 'Escape' key to call the Home screen.

b) Watch **Temperature** for one minute. Is it between 35 and 39° C AND stable (i.e. does NOT vary greater than +/- 0.15° C)?

Yes Check the Temperature Set Point as follows:

a) From the Home screen, select the screen's Temperature window. It turns bright yellow and displays the "Temp Setting".

b) Set Temperature to 37° C.

c) Press the 'CONFIRM' key. The window returns to pale yellow. This establishes the Temperature alarm limits at 39 and 35° C.

d) See procedure number CO- 1.0.10 (page 132).

No Proceed to **page 92**, SECTION 4 – TEMPERATURE PROBLEMS.

CO- 1.0.10 CHECK CONCENTRATE SETTINGS

a) Select the 'Dialysate' tab, at the bottom of the screen, to call the 'CONFIRM Concentrate' screen (see Figure 55, page 129).

b) Proceed accordingly based on if **BICARBONATE** or **ACETATE** (rarely, if ever used) is selected:

- **BICARBONATE IS SELECTED i.e. [Bicarbonate] window NOT = 0: ASSURE** the:
  - Identification ('ID') **AND** 'Type' (45x, 36.83x, etc) of the 'Currently Selected Acid' matches what is connected to the machine per its labeling
  - Value in the [Bicarbonate] window set as it would be for a typical patient treatment. It MUST not be = 0
  - Value in the [Base Na+] (sodium) window set as it would be for a typical patient treatment
  - Red connector in ACID; Blue connector in Bicarbonate
  - Check the bicarbonate's labeling to assure it is the same 'Type' as the selected acid
  - Conductivity (alarm) Limits are set per unit policy

  Proceed to part c.

- **ACETATE IS SELECTED i.e. [Bicarbonate] window = 0: ASSURE** the:
  - Identification ('ID') of the 'Currently Selected Acetate' matches what is connected to the machine per its labeling. ONLY the red connector is attached to 35x (ACETATE) concentrate
  - The bicarbonate (blue) connector in its rinse port
  - 'Type' = 35x
  - Value in the [Base Na+] (sodium) window is set as it would be for a typical patient treatment
  - Conductivity (alarm) Limits are set per policy

  Proceed to part c.

c) Are ALL selections/settings correct?

Yes See procedure number CO- 1.0.11 (page 133).

No a) Perform appropriate selections/settings.

b) Press the 'CONFIRM' key.

c) Allow eight minutes. If Conductivity is still a problem see procedure number CO- 1.0.11 (page 133).

CO- 1.0.11 VERIFY CONDUCTIVITY PROBLEM

a) Call the Home screen.

b) Referring to Figure 56 (page 133), **IMPORTANT!** IGNORE 'Status Bar' Conductivity related messages. Pay attention ONLY to the value in the digital **Conductivity** window!

'Normal' conductivity differs between baths (example: between 1K and 3K), Sodium (Na+) and Bicarbonate settings. Na+ and Bicarbonate levels should be set per a typical patient treatment!

c) Proceed accordingly (three scenarios):

1. **= 17 mS:** See procedure number CO- 1.0.12 (page 133).
2. **Less than 17 mS but higher than normal:** See procedure number CO- 1.0.13 (page 134).
3. **All others:** Allow one minute then see procedure number CO- 2.0.0 (page 135).

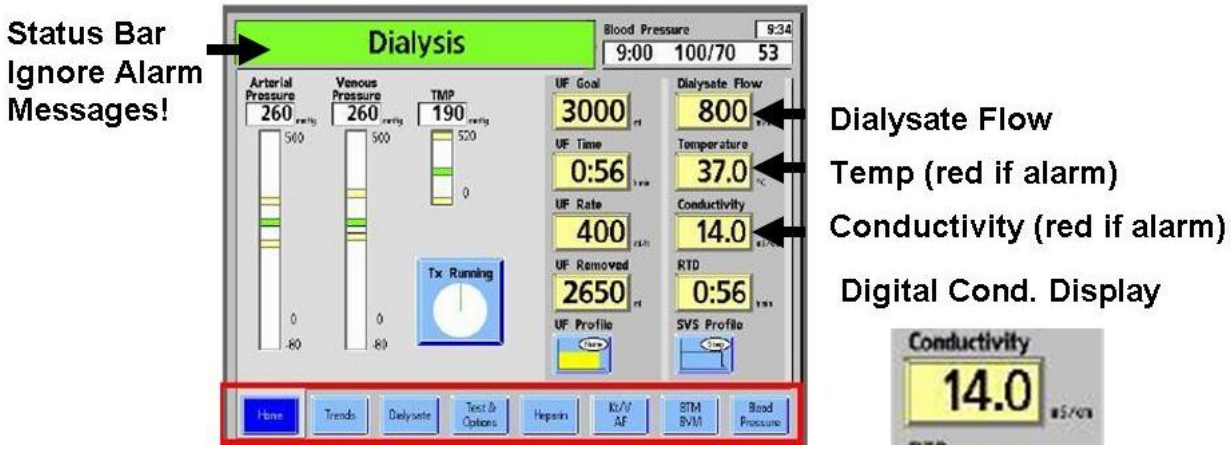


Figure 56 – Home Screen

CO- 1.0.12 CHECK PUMP CONFIGURATION

a) If **bicarbonate** is selected, ASSURE the red connector is attached to ACID and the blue connector is attached to ADEQUATELY mixed bicarbonate. **If not this may be the problem!**

b) Referring to Figure 322 (page 134), momentarily disconnect the red concentrate connector from its source to introduce a small air bolus then watch for bubbles through the Acid/Acetate inlet tubing. This assures the acid pump is drawing.

c) Plug the bicarbonate (blue) concentrate connector into its rinse port. Does the acid pump stop drawing?

Yes **IMPORTANT! To prevent damage turn the machine off!** Referring to Figure 322 (page 134), the acid (Conc-P) and bicarbonate (Bic-P) pump distribution board connectors are reversed.

No
a) Return the bicarbonate connector to concentrate.
b) **IMPORTANT!** Allow three minutes.
c) See procedure number CO- 1.0.13 (page 134).

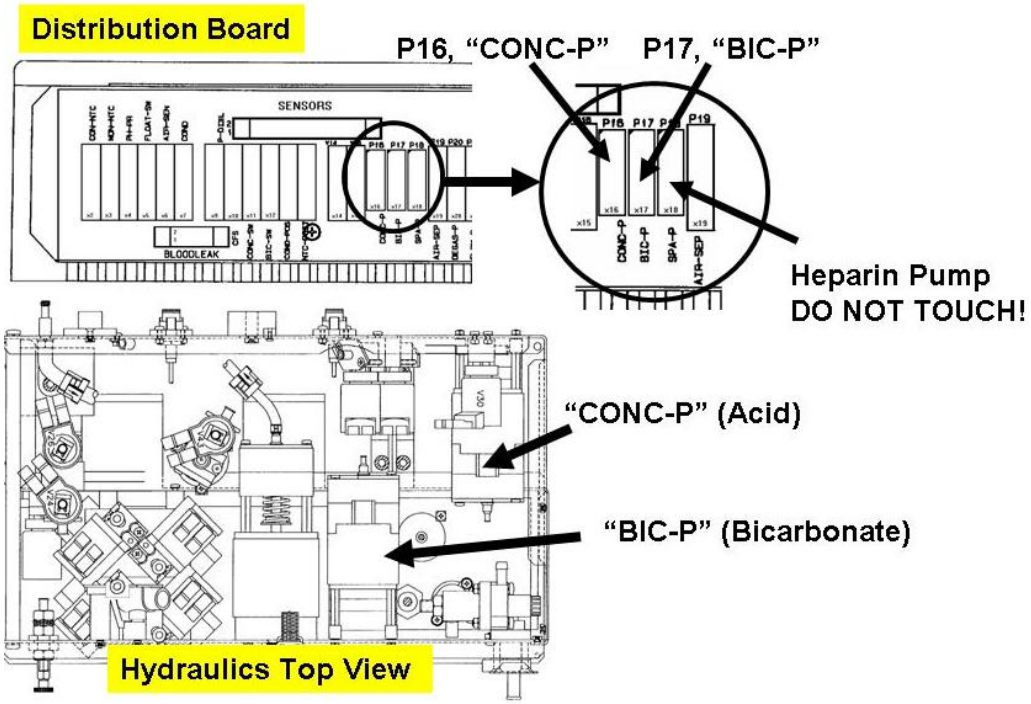
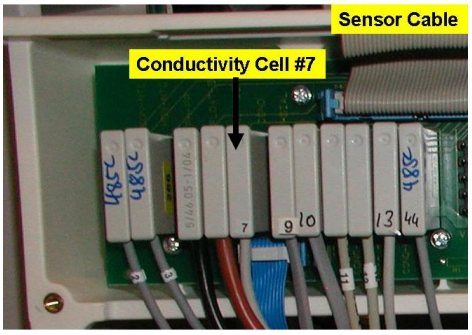


Figure 322 - Pump Configuration

CO- 1.0.13 CHECK CONDUCTIVITY DISPLAY (10 mS)

a) Referring to the Figure (right), from the distribution board, position labeled "COND", unplug the 5th connector cap from the left. This is Conductivity Cell #7. Unplugging it simulates VERY low conductivity.

b) From the Home screen, is **Conductivity** = 10?



Yes a) CAREFULLY return Conductivity Cell #7 to distribution board position labeled "COND".

b) See procedure number CO- 2.0.0 (page 135).

No a) Not likely! **ASSURE that conductivity cell #7 is unplugged from distribution board position labeled "COND"!**

b) If **Conductivity** STILL does NOT = 10, see procedure number CO- 1.0.14 (page 134).

CO- 1.0.14 TROUBLESHOOT CONDUCTIVITY DISPLAY NOT = 10 mS

a) Using a flashlight, check the vacant "COND" distribution board position for 'white' corrosion or damaged **male** pins that may cause false signals. If (and ONLY if) corrosion or damage is located the distribution board may need to be replaced!

b) Return conductivity cell #7 to distribution board position "COND" (**6th position from the left**).

c) **IMPORTANT!** Turn the machine off.

d) Referring to Figure 3 (page 5), unplug the sensor cable from the distribution board.

e) Using a flashlight, check inside, above and below the vacant SENSORS connector for 'white' corrosion and damaged **male** pins that may cause false signals from the distribution board.

f) If (and ONLY if) the SENSORS connector is okay, leaving the sensor cable unplugged, place the machine into Dialysis program (remember to press the 'CONFIRM' key). **Ignore all alarms!**

g) Call the Home screen. Is **Conductivity** = 10?

Yes a) **IMPORTANT!** Turn the machine off.

b) Unplug the sensor cable from the sensor board. Check inside the vacant connector for 'white' corrosion and damaged **male** pins. Check both female ends for 'white' corrosion and the sensor cable for damage.

c) Reconnect the cable at **both** ends. Attempt the Cond Cells calibration per procedure. If unsuccessful, replace the sensor cable (see Figure 4A, page 8) and attempt Conductivity Cells calibration again. If still unsuccessful the distribution board may be bad.

No a) **IMPORTANT!** Turn the machine off.

b) Unplug the sensor cable from the sensor board. Check inside the vacant connector for 'white' corrosion and damaged **male** pins. Check both female ends for 'white' corrosion and the sensor cable for damage.

c) Reconnect the cable at **both** ends.

d) Referring to Figure 4A and NOTE B (page 8), swap the following five listed components, one at a time, with known good, attempting Cond Cells calibration in between: 1) Converter board or **new-style power logic board** (depends on how the machine is equipped); 2) sensor cable; 3) Sensor board; 4) Actuator board; 5) Function board; 6) Motherboard

CO- 2.0.0 RE-CHECK TEMPERATURE AND TEMPERATURE ALARM

a) **IMPORTANT!** From the Home screen, watch Temperature for two minutes. If (and ONLY if) **Temperature** is **NOT** between 35.1 and 38.9° C AND stable (+/- 0.1 °C per minute) proceed to **page 92**, SECTION 4 – TEMPERATURE PROBLEMS.

b) Referring to the Figure (right) is the **Temperature** window RED?

Yes a) Per procedure number CO- 1.0.9 (page 132) ASSURE Temperature is set to 37° C.

b) If (and ONLY if) Temperature is between 35.1 and 38.9° C AND is set to 37° C, three possibilities: **1)** Bad actuator board; **2)** Bad sensor board; **3)** Bad function board.

No See procedure number CO- 2.0.1 (page 135).

CO- 2.0.1 CHECK CONDUCTIVITY ALARM

a) **IMPORTANT!** Close the shunt door!

b) Is the **Conductivity** window RED?

Yes See procedure number CO- 2.0.2 (page 135).

No a) If the **Temperature** and **Conductivity** windows are NOT red the Bypass LED (front panel) should be OFF!

b) See procedure number CO- 2.0.5 (page 136).

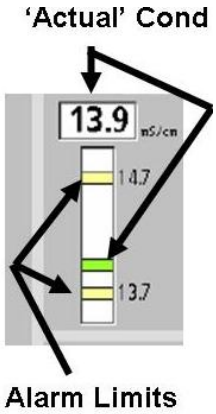
CO- 2.0.2 CHECK CONDUCTIVITY / CONDUCTIVITY CELL FREQUENCY (AFREQ)

Call debug screen 5. Is **AFREQ** less than 1000?

Yes Three possibilities: 1) Bad actuator board; 2) Bad function board; 3) Bad motherboard.

No See procedure number CO- 2.0.3 (page 136).

CO- 2.0.3 ADJUST CONDUCTIVITY ALARM LIMITS



a) Press the front panel's 'Escape' key to call the Home screen.

b) Select the 'Dialysate' tab at the bottom of the screen to call the 'CONFIRM Concentrate' screen.

c) Referring to the Figure (right), if 'actual' Conductivity is NOT remaining between 13.0 and 14.5 mS skip to procedure number CO- 2.0.4 (page 136).

d) Using the screens 'Alarm Position' and/or 'Alarm Width' buttons are you able to adjust the Alarm Limits until 'actual' Conductivity REMAINS between the upper and lower alarm limits?

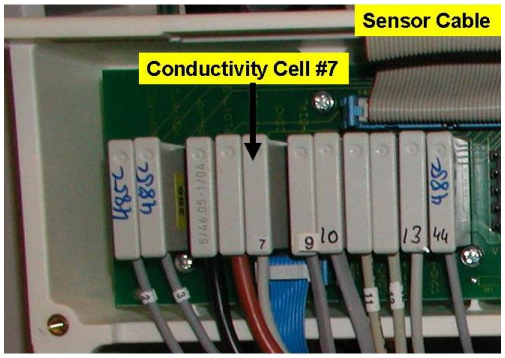
Yes a) **IMPORTANT!** Press the 'CONFIRM' key.

b) From the Home screen, if the **Conductivity** window remains RED see procedure number CO- 2.0.4 (page 136). If the **Temperature** and **Conductivity** windows are NOT red the Bypass LED (front panel) should be off.

c) See procedure number CO- 2.0.5 (page 136).

No See procedure number CO- 2.0.4 (page 136).

CO- 2.0.4 SET CONDUCTIVITY DISPLAY



a) Referring to the Figure (right), from the two-resistor OLC set, place the **274 Ω** resistor plug, into distribution board position labeled "COND" (**6th position from the left**). This simulates 'normal' Conductivity.

b) **CRITICAL**! ASSURE the **274 Ω** plug is placed correctly before continuing!

c) Call the Home screen. Is Conductivity between 13.0 and 14.5 mS?

Yes a) If necessary, adjust the Conductivity alarm limits (per procedure number CO- 2.0.3, page 136) until 'actual' Conductivity is between the alarm limits then **(IMPORTANT!**) press the "CONFIRM' key.

b) From the Home screen, if (and ONLY if) 'actual' Conductivity is remaining between the alarm limits AND the **Conductivity** window remains RED three possibilities: 1) Bad actuator board; 2) Bad function board; 3) Bad motherboard.

c) If the **Temperature** and **Conductivity** windows are NOT red the Bypass LED (front panel) should be off.

d) See procedure number CO- 2.0.5 (page 136).

No See procedure number CO- 6.0.0 (page 145).

CO- 2.0.5 CHECK 'OUT OF BYPASS' FLOW

NOTE: The following procedures require that the machine remains 'out of bypass' (i.e. Bypass LED remains off). If Conductivity is extremely unstable it may cause bypass (Bypass LED on). If (and ONLY if) Bypass occurs intermittently return to procedure number CO- 2.0.4 (page 136).

a) **IMPORTANT!** Set Dialysate flow to 500 ml/min (NOT "a500") and press the 'CONFIRM' key.

b) If flow rate was changed to 500 ml/min allow three minutes for stabilization!

c) Call debug screen 1. If NPHT is less than 600 press and hold the "1" numeric keypad until NPHT is greater than 600. Ignore an "On Line PHT Failed" message if it occurs for now.

d) **IMPORTANT!** Do NOT reset alarms!

e) **IMPORTANT!** With the Bypass LED OFF, is the external flow indicator's (#75) 'bob' rising (at least ¼ way up) and falling (see Figure right)?

Yes See procedure number CO- 2.0.7 (page 137).

No a) If (and ONLY if) the **Temperature** window is RED repeat from procedure number CO- 2.0.0 (page 135).

b) If (and ONLY if) the **Conductivity** window is RED repeat from procedure number CO- 2.0.4 (page 136).

c) Proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM

CO- 2.0.7 CHECK 'OUT OF BYPASS' FLOW STABILITY

Call debug screen 6 and CAREFULLY watch **BC Switch** for one minute. Is it REMAINING between 324 and 396 (3.24 and 3.96 seconds)?

Yes See procedure number CO- 2.0.8 (page 137).

No a) Call the Home screen and make ASSURE Dialysate flow rate is still set 500 ml/min. It may have defaulted to a different rate (idle flow option). If (and ONLY if) selected Dialysate flow is NOT 500 changed return to procedure number CO- 2.0.5 (page 136).

b) Proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM.

CO- 2.0.8 CHECK TEMPERATURE / CONDUCTIVITY

a) Without turning Dialysate flow off, place a calibrated conductivity meter into the dialysate lines.

b) **IMPORTANT!** Close the shunt door!

c) Allow two minutes for the meter reading to stabilize.

d) Set the meter to read Temperature. ASSURING the Bypass LED is REMAINING off, if (and ONLY if) the meter's Temperature reading is NOT remaining between 35.5 and 38.5° C proceed to **page 94**, procedure number **T- 1.0.4**.

e) Set the meter to read Conductivity. ASSURING the Bypass LED is REMAINING off the meter's Conductivity reading is (four scenarios):

NOTE! If using a NEO-1, its display reads [1 .] if measured conductivity is greater than 20 mS!

1. **Remaining lower than 'normal':** See procedure number CO- 8.0.0 (page 149).
2. **Remaining higher than 'normal':** See procedure number CO- 8.0.0 (page 149).
3. **'Normal' and stable (does NOT vary greater than +/- 0.15 mS per minute):** See procedure number CO- 3.0.0 (page 137).
4. **Unstable (varies greater than +/- 0.15 mS per minute):** See procedure number CO- 5.0.0 (page 142).

CO- 3.0.0 VERIFY POSSIBLE CONDUCTIVITY DISPLAY PROBLEM

a) If removed from a previous procedure, CAREFULLY return conductivity cell #7 to distribution board position labeled "COND" (**6th position from the left**).

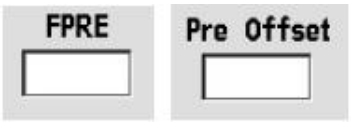
b) From the Home screen, proceed according to the machine's **Conductivity** display (three scenarios):

1. **= 17 mS:** See procedure number CO- 3.1.0 (page 138).
2. **= 10 mS:** See procedure number CO- 3.2.0 (page 138).
3. **= All others:** See procedure number CO- 3.3.0 (page 138).

CO- 3.1.0 CHECK CONDUCTIVITY = 17

a) **IMPORTANT!** Place the machine into Rinse program and allow seven full minutes.

b) Call debug screen 5. Does **FPRE** = **Pre Offset** +/- 400?

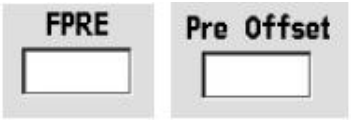


Yes See procedure number CO- 6.0.0 (page 145). .

No Conductivity cell #7 is bad (see Figure 57, page 138).

CO- 3.2.0 CHECK CONDUCTIVITY = 10

Call debug screen 5. Does **FPRE** = **Pre Offset** +/- 10?



Yes Conductivity cell #7 is bad (see Figure 57, page 138).

No See procedure number CO- 6.0.0 (page 145).

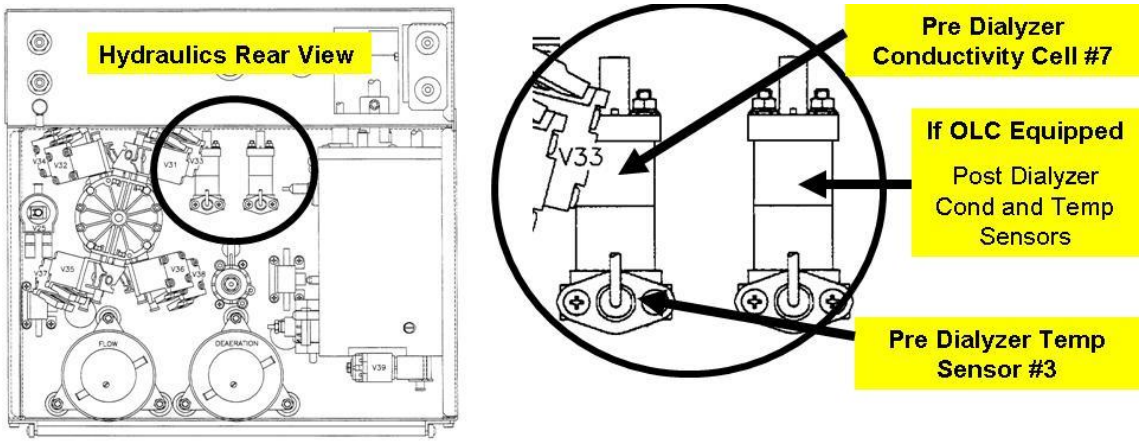


Figure 57 – Hydraulics (Rear View)

CO- 3.3.0 CHECK CONDUCTIVITY

a) If necessary, adjust the Conductivity alarm limits (per procedure number CO- 2.0.3, page 136) until 'actual' Conductivity is between the alarm limits.

b) **IMPORTANT!** With the Bypass LED OFF and flow through the external flow indicator is the external meter's 'actual' reading and the machine's Conductivity display within 0.1 mS of each other?

Yes If (and ONLY if) troubleshooting an OLC problem see procedure number CO- 3.4.0 (page 138). If NOT troubleshooting OLC see procedure number CO- 3.5.0 (page 139).

No See procedure number CO- 6.0.0 (page 145).

CO- 3.4.0 CHECK CONDUCTIVITY / TEMPERATURE STABILITY

a) Call debug screen 1. If **NPHT** is less than 600 press and hold the "1" numeric keypad until **NPHT** is greater than 600. **Ignore an "On Line PHT Failed" message if it occurs**. Allow one minute then continue to part b.

b) Call debug screen 5. Watch **CPRE** for one minute noting the highest and lowest values. Proceed accordingly (two scenarios):

1. **Highest minus lowest less than 70:** Displayed Conductivity is stable. See procedure number CO- 10.0.0 (page 152) to continue troubleshooting OLC problems.
2. **Highest minus lowest greater than 70:** CAREFULLY watch **TPRE** for one minute and note the highest and lowest values. Is highest minus lowest less than 15 (i.e. 0.15° C)?

   Yes Conductivity is unstable. See procedure number CO- 5.0.0 (page 142).

   No Proceed to **page 94**, procedure number **T- 1.0.4**.

CO- 3.5.0 CHECK CONDUCTIVITY AT OTHER FLOW RATES

Check Conductivity stability for other applicable Dialysate flow rates as described below. **Read steps a through f before continuing!**

a) From the Home screen, set Dialysate flow to the desired rate then press the 'CONFIRM' key.

b) Re-check loading pressure at each flow rate. If (and ONLY if) it is NOT 'okay' (per **Table 15**, page 93) proceed to **page 18**, procedure number **F- 2.0.4**.

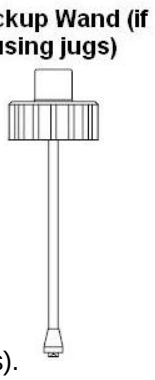
c) Allow **five minutes** for stabilization at flows greater than 200 ml/min. If flow is set to 200 ml/min or less allow **15 minutes**.

d) Call debug screen 0 AND while waiting for stabilization, CAREFULLY watch **Flow Error**. If (and ONLY if) **Flow Error** = 1 (intermittently or constant) proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM. If a "No Water" message appears proceed to **page 64**, SECTION 2 – NO WATER.

e) Call the Home screen if **Conductivity** is not remaining stable see procedure number CO- 5.0.0 (page 142).

f) Repeat parts a through f for all applicable flow rates. If Conductivity remains stable do NOT continue!

CO- 4.0.0 CHECK CONCENTRATE INLET SYSTEMS



a) Proceed accordingly (based on if **using Jjgs** or **Central Delivery (SDS)**):

1) Using Jug(s):

- ASSURE the jug(s) are full and the pickup wand(s) are fully submersed. **If not this may be the problem!**
- ASSURE concentrate connector(s) are inserted tightly into the pickup wand(s). **If not this may be the problem!**

2) Using central delivery (SDS):

- ASSURE the concentrate connector(s) are inserted tightly into the SDS outlet port(s). **If not this may be the problem!**
- ASSURE adequate flow from the station valve(s). I**f not this may be the problem!**

b) See procedure number CO- 4.1.0 (page 139).

CO- 4.1.0 CHECK CONCENTRATE INPUT

a) Place the machine into Rinse program for 20 seconds (to assure the pumps are primed).

b) Call debug screen 1. Watch **NO EOS** AND **ALWEOS** for **30 seconds**. If (and ONLY if) either = 1 proceed to page 161, SECTION 6 - CONCENTRATE PUMP ERRORS.

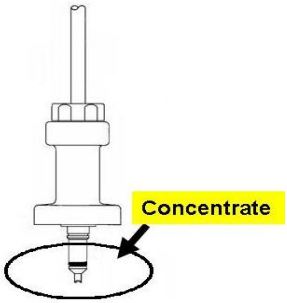
c) Connect to concentrate and return to Dialysis program (remember to press the 'CONFIRM' key).

d) Is AIR FREE concentrate drawn steadily in one direction now?

Yes Allow **eight minutes**. If Conductivity REMAINS low, return to procedure number CO- 1.0.0 (page 128).

No See procedure number CO- 4.2.0 (page 140).

CO- 4.2.0 ISOLATE CONCENTRATE PICKUP SYSTEMS



a) Place the machine into Rinse program for 20 seconds (to assure the pumps are primed).

b) Referring to the Figure (right), place the 'male probe' **ONLY** into a container of concentrate (**i.e. do NOT submerse the whole connector)!**

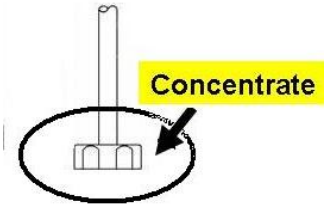
c) Return to Dialysis program (remember to press the 'CONFIRM' key).

d) Is AIR FREE concentrate drawn steadily in one direction now?

Yes There is a problem with the pickup wand (if using a jug) or the central concentrate (SDS) delivery system.

No See procedure number CO- 4.3.0 (page 140).

CO- 4.3.0 ISOLATE CONCENTRATE CONNECTORS



a) Return to Rinse program for 20 seconds (to assure the pumps are primed).

b) Referring to the Figure (right), remove the connector from the inlet tubing and submerse the tubing, **without the filter(s),** into concentrate.

c) Return to Dialysis program (remember to press the 'CONFIRM' key).

d) Is AIR FREE concentrate being drawn steadily in one direction now?

Yes Referring to Figure 58 (page 140), there is a problem with the concentrate connector.

No Turn the machine off then see procedure number CO- 4.5.0 (page 140).

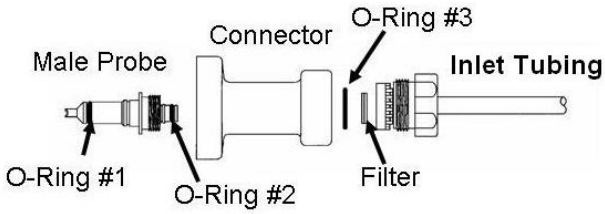


Figure 58 – Concentrate Connectors

CO- 4.5.0 CHECK VALVES INSTALLED?

a) Referring to Figure 59 (page 141), if the machine is equipped for SDS (central acid and/or bicarbonate delivery) there may be 6 psi check valves (P/N 150209, red bodies with white inserts) installed in the concentrate pump's tubing either before or after the pump(s). **NOTE: Figure 59 shows the check valves before the pumps but outside the machine. They are more likely are inside!**

b) Are the (white insert) check valve(s) installed?

Yes See procedure number CO- 4.6.0 (page 141).

No See procedure number CO- 4.7.0 (page 141).

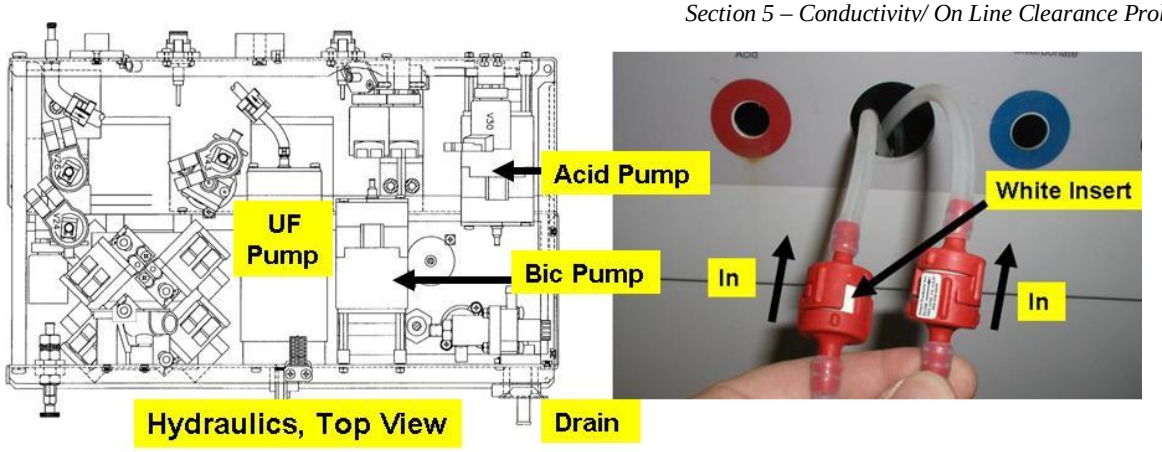
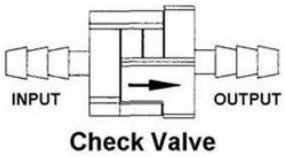


Figure 59 – Hydraulics Top View / Central Check Valves

CO- 4.6.0 ISOLATE THE CHECK VALVES



Check Valve

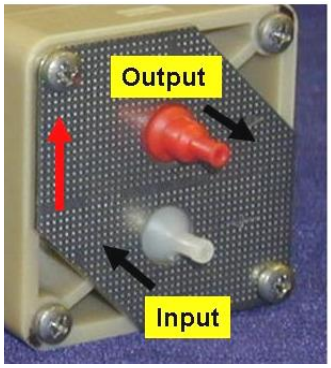
Referring to the Figure (right), **check valves** must be oriented properly If accidently reversed they block flow. **Arrows (→) on the red body indicate their direction of flow**:

Remove the check valve's INPUT tubing and attach a syringe, with tubing attached, to the empty nozzle. Are you able to push through the check valve(s)?

Yes CAREULLY reinstall the check valve(s) (ASSURE correct ORIENTION) then see procedure number CO- 4.7.0 (page 141). **NOTE:** If a (white inserted) check valve was recently installed perform Heat Disinfect twice to 'break in' their tension springs.

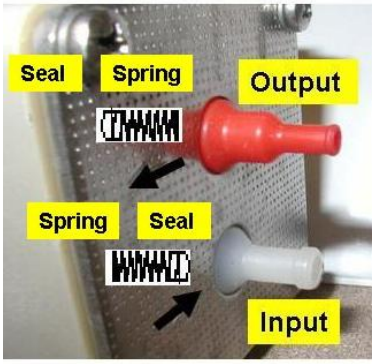
No The check valve(s) are oriented incorrectly or are bad.

CO- 4.7.0 ISOLATE THE CONCENTRATE PUMP(S)



a) Referring to the Figure (right). Three checks:

1. Assure the nozzles are installed correctly per the arrows (→) on the mounting plate. Colored nozzle at the 'output' (→) port; White nozzles at the 'input' (←) port.
2. Assure the input (clear tubing) and output (solid tubing) is plumbed to the appropriate nozzles.
3. Assure the pumps are installed with the output (colored) nozzles towards the TOP of the machine.



b) Referring to the Figure (right) disassemble the pump (see Figure 59, page 141. Six checks:

1. Check for broken or bent inlet/outlet springs.
2. Assure the springs and seals are oriented correctly.
3. Check or replace the seals and o-rings.
4. If the machine is OLC equipped assure that a 'strong' spring is not installed. BOTH springs should be 'weak'.
5. Check for a torn diaphragm.
6. If a problem is not found, three possibilities: **1)** Bad 6 psi check valve (if equipped, see Figure 59, page 141); **2)** Bad pump); **3)** Bad actuator board.

CO- 5.0.0 CHECK FOR AIR

a) If removed from a previous procedure CAREFULLY return conductivity cell #7 to distribution board position labeled "COND" (**6th position from the left**).

b) Re-check loading pressure. Per Table 21 (page 129), it MUST be **fluctuating** to its maximum **AND** NEVER dropping below the specified minimum. Watch both levels for two minutes. If (and ONLY if) it is not 'okay' proceed to **page 18**, procedure number **F- 2.0.4**.

c) Referring to the Figure (right), using a flashlight, check for air bubbles through the clear tubing at Conductivity cell #7. If (and ONLY if) air is seen proceed to **page 206**, procedure number **AIR- 1.0.5**.

d) Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks) and allow one minute for the deaeration pump to stop (debug screen 1, **DEAP** =255).

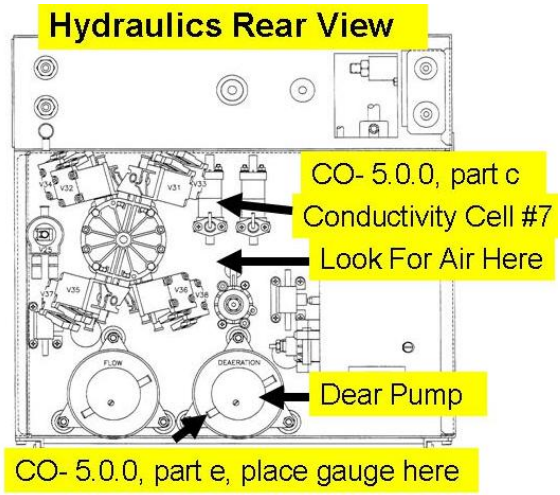
e) Referring to the Figure (right), tee a gauge to the input of the deaeration pump.

f) Turn Dialysate flow ON (Dialysate Flow on/off LED off).

g) Referring to Appendix A (page 260), is Deaeration pressure okay?

Yes See procedure number CO- 5.2.0 (page 142).

No See procedure number CO- 5.1.0 (page 142).



CO- 5.1.0 CALIBRATE DEAERATION PRESSURE

Calibrate DEAERATION AND LOADING PRESSURE per procedure. Is the calibration successful?

Yes a) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

b) Allow eight minutes. If Conductivity is still unstable see procedure number CO- 5.2.0 (page 142).

No Proceed to page 211, SECTION 13 - DEAERATION PROBLEMS.

CO- 5.2.0 CHECK FOR MOTOR NOISE

Call debug screen 3. Is **!ECH** AND/OR **!ACK** greater than 3?

Yes Turn the blood pump off then turn the machine off, back on and place it into Dialysis Program. Check **!ECH** and **!ACK** again. If remaining less than 3 replace the blood pump motor. If continuing to increase check the deaeration and flow motors for excessive carbon build up and/or bad brushes.

No See procedure number CO- 5.3.0 (page 142).

CO- 5.3.0 FLOW STABILITY CHECK

a) From debug screen 1, if **NPHT** is less than 300 press and hold the "1" numeric keypad until **NPHT** is greater than 600. **Ignore an "On Line PHT Failed" message if it occurs**.

b) Call the Home screen and **NOTE** the **selected** Dialysate Flow rate. ASSURE it is NOT set to "a300", "a500" or "a800". If Dialysate flow rate is or was changed allow three minutes for stabilization. **If Flow is manually changed remember to press the 'CONFIRM' key.**

c) Call debug screen 1 and ASSURE **FILACT** = 0 constant. If FILACT = 1 there is an air leak!

d) **IMPORTANT!** Do NOT reset alarms!

e) Call debug screen 6 and CAREFULLY watch **BC Switch** for one minute. Referring to Table X (page 143) is it remaining between the indicated times for the NOTED **selected flow rate**?

Yes See procedure number CO- 5.4.0 (page 143).

No a) Call the Home screen and check the selected flow rate. It may have defaulted to a different rate other than what was noted above (idle flow option). If (and ONLY if) flow rate has changed repeat procedure number CO- 5.3.0 (page 142).

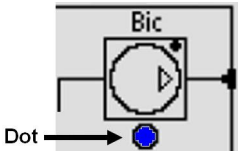
b) Proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM

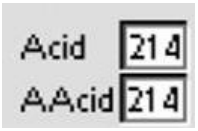
Table X

If NOTED selected Dialysate Flow rate is	BC Switch between:
300 ml/min	540 and 660 (5.40 – 6.60 seconds)
500 ml/min	324 and 396 (3.24 – 3.96 seconds)
800 ml/min	203 and 248 (2.03 – 2.48 seconds)

CO- 5.4.0 CHECK PUMP STEPS

a) Call debug screen 0 and watch the following for several minutes to look for an intermittent problem (three checks). See Figures (right):





1) If (and ONLY if) bicarbonate concentrate is selected AND the blue connector is plugged into concentrate, the **Bicarbonate (BIC) pump's 'indicator dot'** should REMAIN blue. If (and ONLY if) it turns white see procedure number CO- 9.0.0 (page 152).

2) **ACID** AND **AACI**. The values do not matter but should ALWAYS remain within +/- 3 of each other. If not, the acid pump or actuator board may be bad.

3) **BIC** AND **ABIC**. The values do not matter but should ALWAYS remain within +/- 3 of each other. If not, the bicarbonate pump or actuator board may be bad.

b) See procedure number CO- 5.5.0 (page 143).

CO- 5.5.0 ON LINE PRESSURE TEST (CHECK BALANCING CHAMBER VALVES)

From debug screen 1, is **NPHT** (upper right) REMAINING = 720?

Yes On Line PHT is not activated! Enter Service Mode → Options → Hardware Options. Set ONLINE PHT to "yes". Press the 'CONFIRM' key ("yes" = blue). Return to Dialysis program and repeat procedure number CO- 5.5.0 (page 143). **NOTE! Fresenius recommends that ON LINE PHT is activated!**

No a) Press and hold the numeric key pad #1 key until **PHTACT** = 1 (test running).

b) When **PHTACT** = 0 (test complete), once again, press and hold the numeric key pad #1 key until **PHTACT** = 1.

c) When **PHTACT** = 0 note **PHT0** and **PHT1**.

d) Proceed according to Table V (page 144).

Table V- On Line PHT

PHT0	PHT1	Response:
Less than 25	Less than 25	See procedure number CO- 5.6.0 (page 144).
Greater than 25	Less than 25	See CO- 5.5.2 (page 144).
Less than 25	Greater than 25	See CO- 5.5.2 (page 144).
Greater than 25	Greater than 25	**Secondary Volumetric Leak:** Proceed to **page 199,** procedure number **PHT- 8.1.0**.

CO- 5.5.2 TROUBLESHOOTING LEAK FAILURE

NOTE this procedure and page number in case you need to return here:

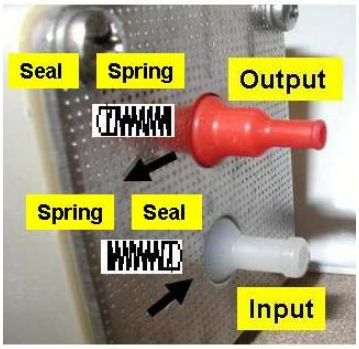
a) **NOTE** nine leak tests will be performed: **1)** IOS; **2)** Balancing Chamber Valves #31 through #38. See SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

b) If a leak is not located see procedure number CO- 5.6.0 (page 144).

CO- 5.6.0 TROUBLESHOOTING UNSTABLE CONDUCTIVITY

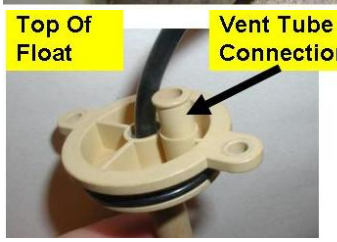
NOTE this procedure and page number, in case you need to return here:

1. Re-check loading pressure. Per Table 21 (page 129), it MUST be **fluctuating** to its maximum **AND** NEVER dropping below the specified minimum. Watch both levels for two minutes. If (and ONLY if) it is not 'okay' proceed to **page 18**, procedure number **F- 2.0.**4.
2. If not already performed in THIS Troubleshooting session, perform SECTION 19 - TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM (page 238).
3. If the machine is OLC equipped ASSURE that a 'strong' spring was not accidentily installed at the output port of the concentrate pumps. Both springs in each pump should be 'weak'.
4. Perform SECTION 12 - INDUCED POSITIVE PRESSURE TESTS (page 208) to check for external water leaks.
5. See procedure number CO- 5.7.0 (page 144).



CO- 5.7.0 CHECK HYDRO BLOCK/ HYDRO CHAMBER

This procedure pressurizes the Hydro Block / Hydro Chamber to approximately 20 psi to locate a potential external leak. A clamp and the **274 Ω** resistor plug, from the two-resistor OLC set, is required.

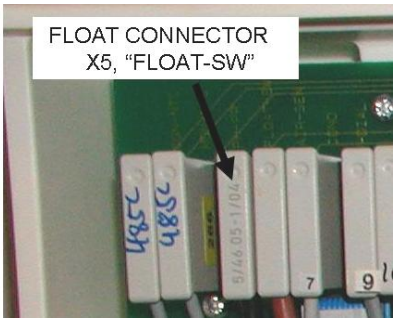


a) Referring to the Figure (right), at the top of the hydro block, tie wrap the segment of vent tubing that is attached to the float.

b) Referring to the Figure (below, right), place the **274 Ω** plug, from the two-resistor OLC set, into the float's distribution position labeled "FLOAT-SW" (**3rd connector cap from the left**). This simulates a closed float switch and opens incoming water valve #41.

c) If the **274 Ω** plug is placed correctly vent tubing overflow occurs within 30 seconds.

d) **Clamp** the vent tubing. This pressurizes the Block/Chamber to approximately 20 psi (per incoming water regulator #61).



e) Check the top and bottom of the Block/Chamber. External water leak located?

Yes Proceed to **page 214**, procedure number **DAIR- 7.0.0**.

No a) Return the float connector to distribution board position "FLOAT-SW"

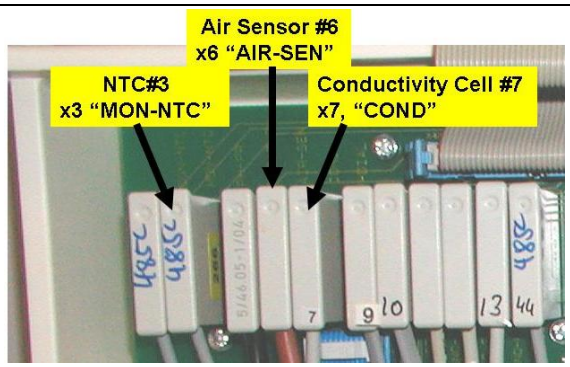
b) **IMPORTANT!** Unclamp the vent tubing.

c) The Troubleshooting Guide is unable to locate an immediate problem. See procedure number CO- 6.0.0 (page 145).

CO- 6.0.0 CALIBRATE CONDUCTIVITY (COND CELLS)

WARNING! Before entering Service Mode it is critical that the machine is NOT issuing a "No Water" alarm, loading pressure is good, and the machine is TOTALLY free Flow Errors (debug screen 1, Flow Error = 0 (constant). Alarm banners do NOT occur in Service mode!

This is NOT a routine Conductivity Cells Calibration! Follow these procedures carefully to avoid error!



a) Referring to the Figure (right), **IMPORTANT!** ASSURE the connector labeled #3 (NTC #3) is plugged into the **2nd** distribution board **position from the left**).

b) **IMPORTANT!** ASSURE the connector labeled #7 (conductivity cell #7) is plugged into the **6th** distribution board position from the labeled "COND".

c) Assure the air sensor connector, labeled #6, is plugged into distribution board position "AIR-SEN". A resistor plug may have been placed here previously.

d) Using fresh concentrate, enter Service Mode → Calibrate Sensors → Cond Cells.

NOTE! If using a NEO-1 meter attach its ground strap to the machines redundant ground (see Figure 6, page 13)

e) Follow the screen's instructions through step #4, "Waiting until the Conductivity value is stable".

f) Allow up to eight minutes. The [Conductivity] data box remains gray until the pre-dialyzer Conductivity Cell #7 stabilizes causing step #5, "Conductivity value is stable…." to appear and the [Conductivity] data box turns from gray to yellow. **IMPORTANT!** After allowing six full minutes (four checks):

1) If (and ONLY if) the external meter's Temperature is NOT between 35.5 and 38.5° C AND remaining stable (+/- 0.15° C per minute) see procedure number CO- 6.0.1 (page 146).

2) The external meter's Conductivity reading MUST stabilize to a 'normal' value. Compare to other machines using the same concentrate that you are calibrating with. **Do NOT enter abnormally low or high conductivities!** If (and ONLY if) Conductivity is too high or too low place the machine into Dialysis program (remember to press the 'CONFIRM' key) then CO- 8.0.0 (page 149).

3) If (and ONLY if) the external meter's Conductivity reading varies greater than +/- 0.15 mS per minute see procedure number CO- 6.0.1 (page 146).

4) If (and ONLY if) the external meter's Conductivity is stable but the screen's [Conductivity] data box is unstable (varies greater than +/- 0.15 mS per minute) record (or you may forget) that there may be a problem with **PRE-DIALYZER** Conductivity cell #7 then see procedure number CO- 7.0.0 (page 146).

g) Select the [Conductivity] data box (it turns bright yellow) and enter the external meter's reading.

h) Press the 'CONFIRM' key (the screen changes) then see procedure number CO- 6.0.2 (page 146).

CO- 6.0.1 CHECK TEMPERATURE

a) Set the external meter to read Temperature. If (and ONLY if) it is NOT between 35.5 and 38.5° C AND stable (+/- 0.15° C per minute) place the machine into Dialysis program (remember to press the "CONFIRM' key) and proceed to page 92, SECTION 4 – TEMPERATURE PROBLEMS.

b) If (and ONLY if) Temperature is between 35.5 and 38.5° C AND is stable place the machine into Dialysis program (remember to press the 'CONFIRM' key) then see procedure number CO- 5.0.0 (page 142).

CO- 6.0.2 CALIBRATE POST DIALYZER CONDUCTIVITY CELL #13 (IF OLC EQUIPPED)

a) How to proceed depends on if the machine has On Line Clearance (OLC) equipped and activated:

- **OLC is not activated:** Press the 'CONFIRM' key. The machine should now operate properly.
- **OLC is activated:** The screen says "Connect the Lines to a Large Dialyzer…" This "four point" calibration establishes slope for the post-dialyzer conductivity cell #13. Using a dialyzer (see **NOTE) is IMPORTANT for accurate OLC calculations as it accounts for dialyzer temperature drop. **If a dialyzer is NOT used 'OLC Cancels' may occur**. Install the dialyzer then press the 'CONFIRM' key.

b) After no more than 10 minutes, does the screen advance to "second point for post conductivity cell"?

Yes After no more than 20 minutes the remaining three points should complete. In this event, press the 'CONFIRM' key to save the calibration. The machine should operate normally! If (and ONLY if) calibration 'sticks' at one of points see procedure number CO- 6.0.3 (page 146).

No Post dialyzer conductivity cell (#13) is NOT remaining stable. See procedure number CO- 6.0.3 (page 146).

**** NOTE:** Assure the fibers are primed and the blood ports are tightly capped to prevent air leaks!

CO- 6.0.3 POST DIALYZER CONDUCTIVITY NOT STABILIZING

a) VERY CAREFULLY check for air flowing through the dialyzer and dialysate lines. Air will NOT allow stabilization and MUST be eliminated!

b) If (and ONLY if) no air is seen, **IMPORTANT!** Record (or you may forget) that there may be a problem with the POST-DIALYZER Conductivity cell #13 then see procedure number CO- 7.0.0 (page 146).

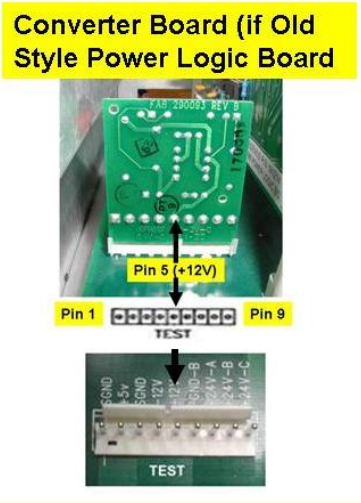
CO- 7.0.0 CHECK POSITIVE (+) 12 VOLT DC SUPPLY

a) Open the card cage. Place a volt meter's ground (black) lead on chassis ground (see Figure 1, page 3).

b) Referring to Figure 60 (page 147), if the machine is equipped with the ***old style power logic board*** it requires the '+12 to -12 volt Converter Board'. This miniature circuit board uses the motherboard's TEST connector. If equipped with the ***new style power logic board*** (released 2008) the 'Converter Board' should NOT be present (i.e. the motherboard's TEST connector should be empty!).

c) Proceed accordingly to check for +12 volts DC (see Figure right):

- ***Old style power logic board*:** Measure at the solder (rear) side of the 'Converter Board' at *pin 5* (five pins from the left) then see part d.
- ***New style power logic board*:** Measure directly from the empty TEST connector at *pin 5* (five pins from the left) then see part d.



d) Between +11.7 and +12.3 volts DC AND stable (does not vary greater than 0.1)?

Yes See procedure number CO- 7.0.1 (page 147).

No Replace with a new style power logic board (assure the 'Convertor' board is NOT present) OR with an old style power logic board AND a 'Convertor' board [1, 2]

[1] **CAUTION!** To avoid damage, the 'Convertor' board MUST be installed with the 'solder side' towards the front of the machine AND matched exactly pin for pin to the TEST connector.

[2] If the problem still exists (bad -12 volts or unstable -12 volts) after replacement proceed to **page** Error! Bookmark not defined., SECTION 24 – TROUBLESHOOTING POWER DISTRIBUTION.

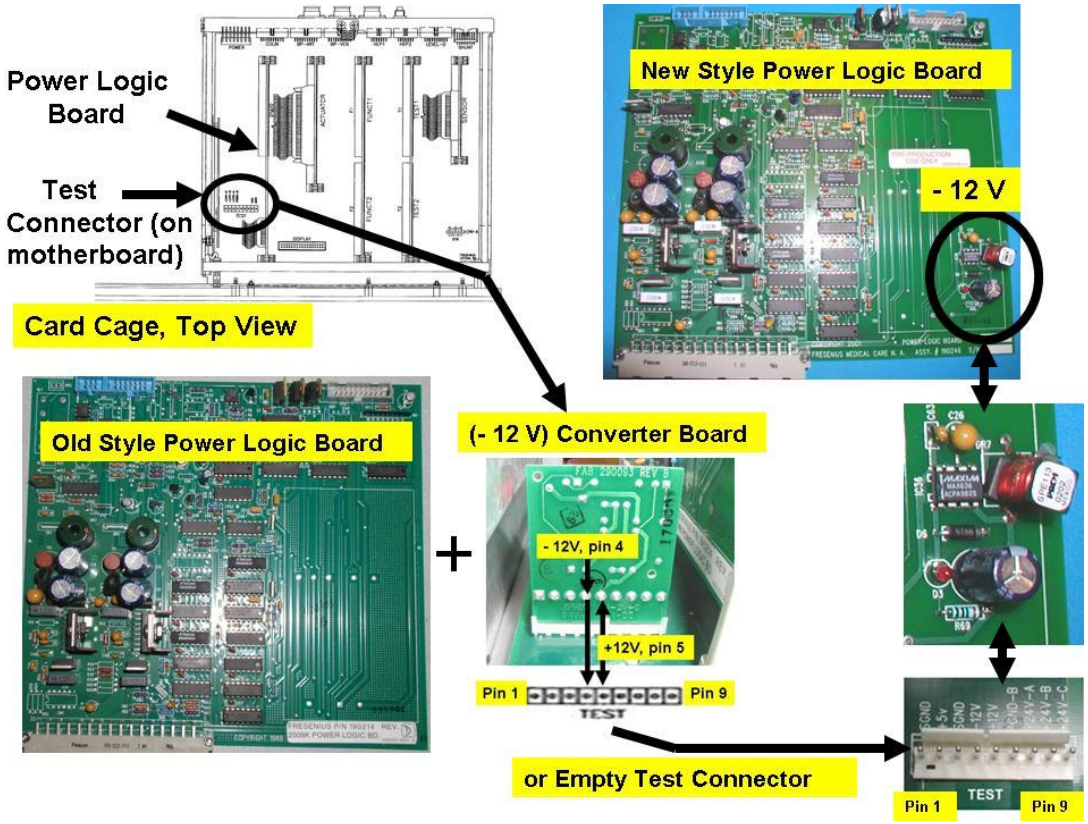


Figure 60 – Old Style / New Style Power Logic Board / Test Connector

CO- 7.0.1 CHECK NEGATIVE (-) 12 VOLT DC SUPPLY

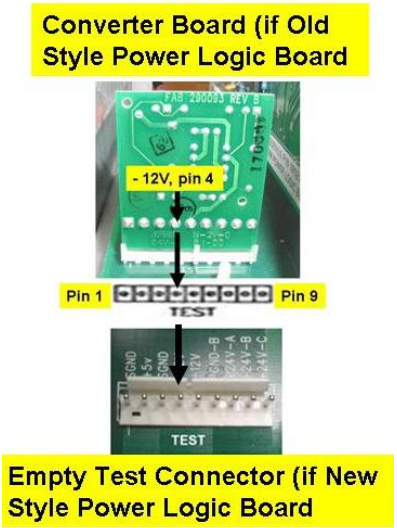
a) Proceed accordingly to check for -12 volts DC (see Figure right):

- ***Old style power logic board*:** Measure at the solder (rear) side of the 'Converter Board'; at *pin 4* (four pins from the left) then see part b.
- ***New style power logic board*:** Measure directly at the empty TEST connector at *pin 4* (four pins from the left) then see part b.

b) Between -11 and -13 volts DC AND stable (does not vary greater than 0.1)?

Yes See procedure number CO- 7.0.3 (page 148).

No Proceed to **page 167**, procedure number **CR- 1.0.3**.



CO- 7.0.3 CHECK PRE-DIALYZER CONDUCTIVITY

a) Place the **274 Ω** resistor plug, from the two resistor set, into conductivity cells #7 distribution board position "COND" (**6th position from the left**).

b) Place the **6.04 KΩ** resistor plug into NTC #3's distribution board position "MON-NTC" (**2nd position from the left**).

c) **Be CAREFUL to follow the instructions exactly here!** Attempt Cond Cells calibration again. After no more than 5 minutes, does the screen's Conductivity data box stabilize and advance to step #5, "Conductivity value is stable…." and the Conductivity data box turn yellow (active)?

Yes **CAUTION!** Do NOT press the 'CONFIRM' key. See procedure number CO- 7.0.4 (page 148).

No a) CAREFULLY return conductivity cell #7 to distribution board position "COND" and NTC #3 to distribution board position "MON-NTC".

b) Swap the following components, one at a time, with known good, attempting Cond Cells calibration in between: 1) Actuator board; 2) Sensor board; 3) Function board; 4) Distribution board.

CO- 7.0.4 VERIFY CONDUCTIVITY CELL PROBLEM (PRE OR POST)

Was the recorded problem (from procedure numbers CO- 6.0.0 or CO- 6.0.3) with the **pre- dialyzer** OR **post-dialyzer** conductivity cell (proceed accordingly)?

- **Pre-Conductivity Cell (#7):** Replace conductivity cell #7 (see Figure 57, page 138).
- **Post-Conductivity Cell (#13):** See procedure number CO- 7.0.5 (page 148).

CO- 7.0.5 ISOLATE POST DIALYZER CELL

a) Escape the calibration then repeat the Cond Cells calibration **but this time** do NOT use the dialyzer.

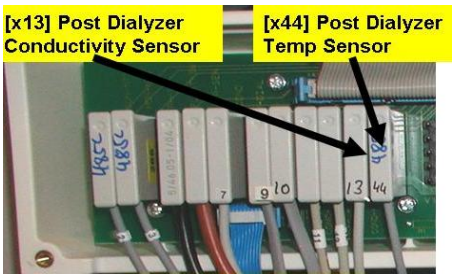
b) After no more than 30 minutes, does the post-dialyzer Cond Cells calibration complete all four steps?

Yes 'Escape' the calibration and repeat Cond Cells calibration with a different dialyzer.

No See procedure number CO- 7.0.6 (page 148).

CO- 7.0.6 TROUBLESHOOT POST-DIALYZER CONDUCTIVITY

a) With the post-dialyzer calibration screen remaining active, place the **274 Ω** resistor plug, from the two resistor OLC set, into conductivity cell #13's distribution board position "x13" (10 **connectors** from the left, see Figure right).



b) Is the Frequency data box between 9800 and 11000 Hz **AND** stable (+/- 5)?

Yes The post dialyzer conductivity cell #13 may be bad (see Figure 309, page 154).

No Swap the following components, one at a time, with known good, attempting Cond Cells calibration in between: 1) Actuator board; 2) Sensor board; 3) Function board; 4) Distribution board.

CO- 8.0.0 CHECK CONCENTRATE(S)

a) If removed from a previous procedure, return conductivity cell #7 to distribution board position labeled "COND" (**6th position from the left**).

b) Check concentrates accordingly:

- **If using central (SDS) delivery:** Swap to a station where a machine has 'normal' conductivity
- **If using jugs:** Swap concentrate(s) with another machine that has 'normal' conductivity

c) From Dialysis program, and with Dialysate flow ON (Dialysate Flow on/off LED off), allow **8 minutes.** Does conductivity become 'normal'?

Yes The previous concentrate supply is bad.

No Two scenarios. Proceed accordingly):

1. **Conductivity higher than 'normal':** See procedure number CO- 8.0.2 (page 149)
2. **Conductivity lower than 'normal':** See procedure number CO- 8.0.6 (page 150).

CO- 8.0.2 VERIFY CENTRAL (SDS) DELIVERY SYSTEM

a) Referring to Figure 322 (page 134) ASSURE the pumps are plugged into the distribution board correctly!

b) Excessive central delivery pressure (SDS), greater than 2 psi, may force concentrate through the concentrate pump(s). Is the machine hooked to a central acid **AND/OR** bicarbonate delivery system?

Yes See procedure number CO- 8.0.3 (page 149).

No See procedure number CO- 8.0.4 (page 149).

CO- 8.0.3 CHECK CENTRAL DELIVERY SYSTEM(S) FOR EXCESSIVE PRESSURE

a) If using central acid, place the red (acid) connector into a jug filled with acid.

b) If using central bicarbonate, place the blue connector into a jug filled with fresh bicarbonate.

c) Allow **10 minutes**. Does conductivity return to 'normal'?

Yes Check the central system(s) for high pressure. **NOTE:** Installing 6 psi check valves (P/N 150209, white inserts) in the pump(s) INPUT tubing deceases pressure to the pump(s).

No See procedure number CO- 8.0.4 (page 149).

CO- 8.0.4 CHECK VALVE #29

If valve #29 is leaking, conductive dialysate may circulate into the fresh and causes high conductivity:

a) Referring to Figure 61 (page 150), tightly clamp the input tubing at valve #29.

b) Allow up to **15 minutes**. Does conductivity return to a normal?

Yes See procedure number CO- 8.0.5 (page 150).

No See procedure number CO- 8.0.6 (page 150).

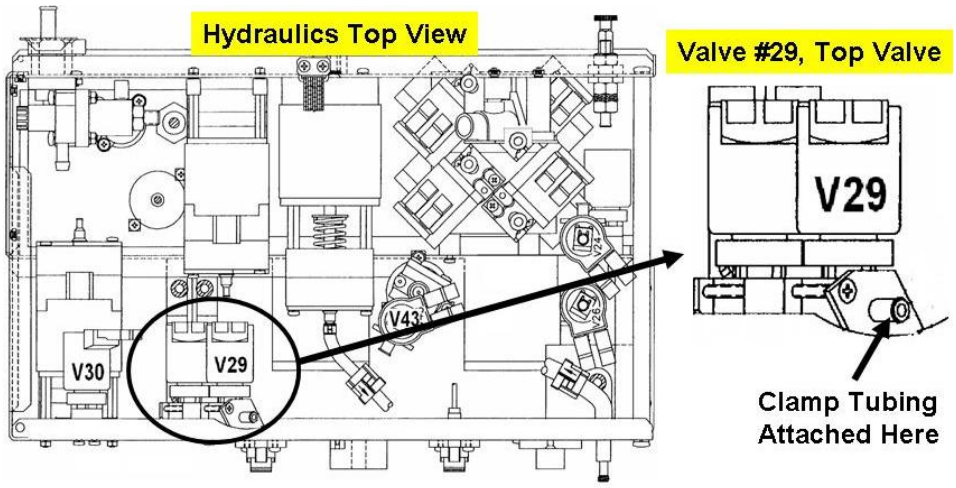
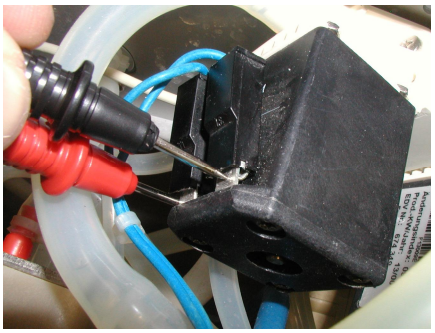


Figure 61 – Valve #29 Check

CO- 8.0.5 ISOLATE ACTUATOR BOARD



a) Leaving the blue wire harness plugged in (see Figure right), measure DC voltage ACROSS valve #29's METAL solenoid terminals.

b) **NOTE!** A reading like 24 mV (0.024 volts)! 24 mV is 24 millivolts

c) Less than 2 V (volts) DC?

Yes Replace valve #29 (leaking).

No Replace the actuator board (see Figure 4A, page 8).

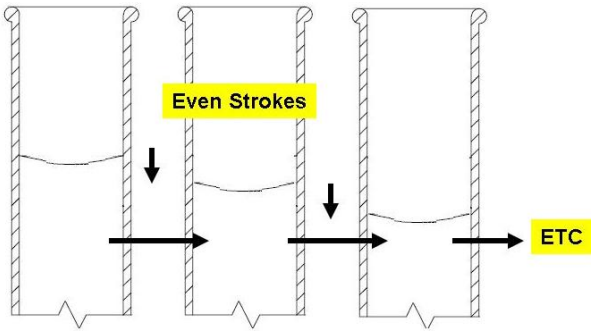
CO- 8.0.6 CHECK PUMP VOLUMES

a) Referring to Figure 59 (page 141), if (and ONLY if) the machine is equipped with the SDS (central acid and/or bicarbonate delivery) 6 psi check valves (P/N 150209, with white inserts) **AND** they were replaced recently perform a couple of heat disinfects then check Conductivity again. This is especially important if Conductivity was okay prior to replacing the check valves!

b) Do **NOT** enter Service Mode. These checks are performed in **Dialysis program** to verify 2% accuracy.

c) **IMPORTANT!** Assure the concentrate inlet tubing is fully primed. **Longer tubing requires extended priming!**

d) Check ACID and BICARB PUMP VOLUMES per Preventative Maintenance Procedures. CAREFULLY watch the burette! **Even, constant** volume should be drawn during **EACH** cycle (see Figure right)! If (and ONLY if) they do not draw evenly see procedure number CO- 4.1.0 (page 139).



e) From debug screen 1, does the acid pump draw between AMIN and AMAX **AND** the bicarbonate pump between BMIN and BMAX?

Yes See procedure number CO- 8.0.7 (page 151).

No Accurately perform ACID and/or BICARBONATE PUMP CALIBRATION per procedure. **IMPORTANT! Assure the concentrate inlet tubing is fully primed. Longer tubing requires extended priming!** If (and ONLY if) a pump won't calibrate see procedure number CO- 4.1.0 (page 139).

CO- 8.0.7 CHECK BALANCING CHAMBER DIAPHRAGMS

NOTE this page and procedure number in case you need to return here:

a) Proceed to page 238, SECTION 19 - TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM.

b) Place the machine into Dialysis program (remember to press the 'CONFIRM' key) then see procedure number CO- 8.0.8 (page 151).

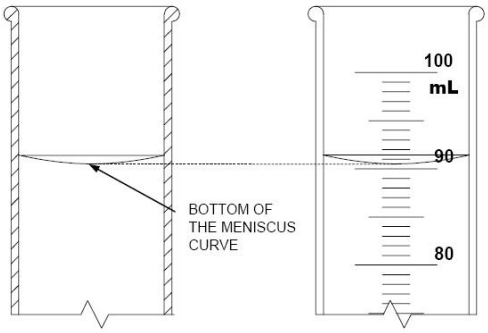
CO- 8.0.8 VERIFY BALANCING CHAMBER VOLUMES

A dry 100 ml graduated cylinder (preferably glass) is required. **Caution! Using a larger cylinder WILL result in gross error! If a calibrated scale is available use it!**

a) Remove the tubing from 'To Drain' (***BOTTOM!**) nozzle at the rear of the machine to expose the drain nozzle. ***CAUTION! Do NOT remove the top tubing!**

b) Turn Dialysate flow ON (Dialysate Flow on/off LED off) and allow 10 pulses to assure flow stability.

c) **Without turning flow off, VERY accurately,** collect two consecutive drain pulses into the 100 ml cylinder. Read the bottom of the meniscus curve (see Figure right).



d) **Two measurements are HIGHLY recommended to assure accuracy! Dry the cylinder in between!**

e) Reconnect the drain tubing.

f) Call debug screen 3. **BCV** (upper right, **B**alancing **C**hamber **V**olume) was entered during the last calibration. It indicates the volume of both balancing chambers.

g) Does **BCV** AND the ACCURATELY measured volume times (x) 10 match?

Yes See procedure number CO- 8.2.0 (page 151).

No Perform BALANCING CHAMBER VOLUME CALIBRATION **and enter your ACCURATELY measured volume**.

CO- 8.2.0 CHECK FOR LEAKING HEAT EXCHANGER

a) **IMPORTANT!** Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks).

b) Referring to Figure 62 (page 152) remove the front clear tubing (to drain) from the heat exchanger's nozzle.

c) Watch for one minute. Is water continually dripping from the heat exchanger's nozzle?

Yes Replace heat exchanger's plate (P/N 650775).

No a) Return the tubing to the heat exchanger.

b) Turn Dialysate Flow ON (Dialysate Flow on/off LED off).

c) See procedure number CO- 5.0.0 (page 142).

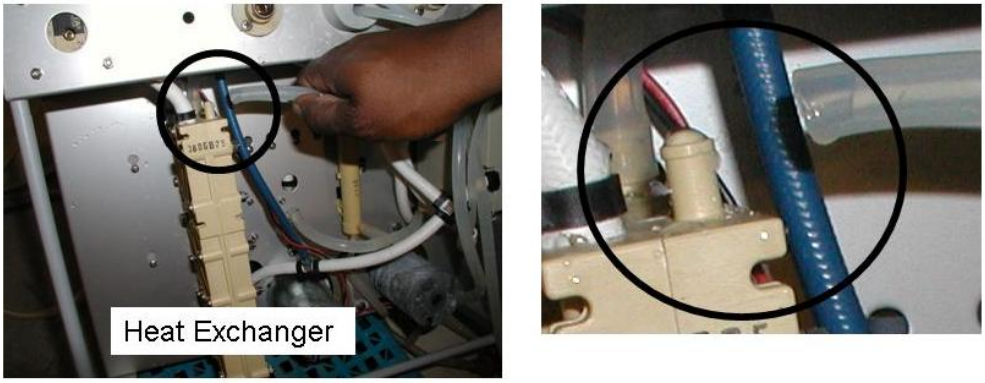
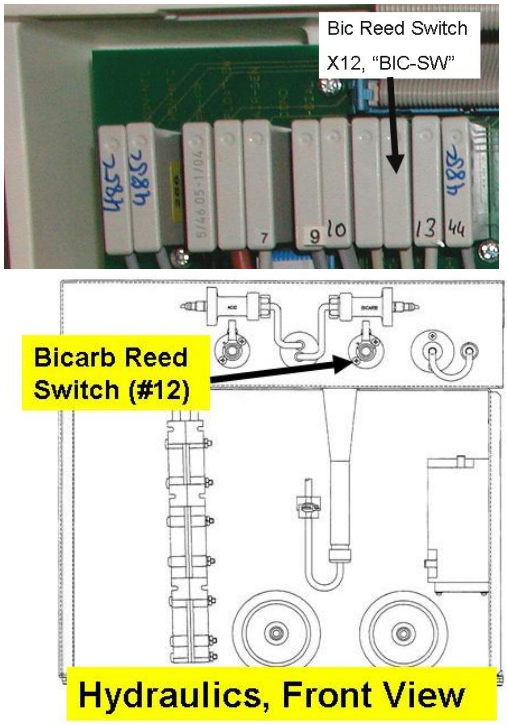


Figure 62 – Heat Exchanger Check

CO- 9.0.0 CHECK BICARB DEBUG SIGNAL



a) Referring to the Figure (right), unplug the BIC Reed Switch from distribution board position labeled x12, "BIC-SW" (**9th connector cap from the left**).

b) From debug screen 2, watch **BICOUT** for several minutes in the event of an intermittent failure. Does **BICOUT** REMAIN = 1?

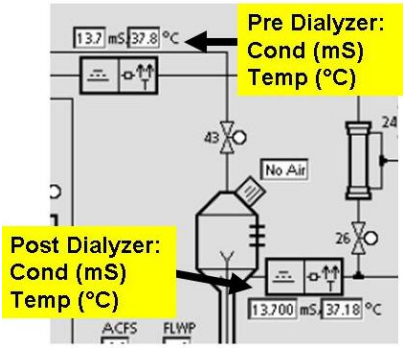
Yes Referring to the Figure (right), replace Bicarbonate reed switch #12.

No
a) Using a flashlight, check **inside** the vacant x12 position for 'white' corrosion or damaged **male** pins that may cause false signals.

b) Leaving the BIC Reed Switch unplugged, three possibilities: 1) Bad actuator board; 2) Bad Function board*; 3) Bad distribution board.

* Swap in a known good function board. Enter Service Mode → Options → Hardware Options. Set T and C (Test and Calibration) to "Yes". Press the 'CONFIRM' key (the "x" turns blue). From debug screen 2, if BICOUT = 1 the previous function board is bad.

CO- 10.0.0 TROUBLESHOOTING OLC



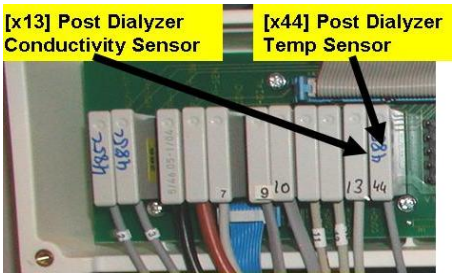
Call debug screen 0. Referring to the Figure (right), two checks:

1. Is the **Post Dialyzer** TEMP data box greater than 34°C?
2. Is the **Post Dialyzer** COND data box greater than 0 mS?

Yes (to both): See procedure number CO- 10.1.0 (page 153).

No (to one OR both): **NOTE** a problem with either or both the Post Dialyzer TEMP or COND sensor then see procedure number CO- 10.2.0 (page 154).

CO- 10.1.0 CHECK POST DIALYZER TEMPERATURE SENSOR



a) Referring to the Figure (right) and Figure 309 (page 154) check the entire length of post dialyzer's Conductivity and Temperature Sensor's wiring harness's for insulation damage or extreme 'stickiness' (due to heat). **Replace the sensor if damage is located!**

b) Referring to the Figure (right), unplug the Post-Dialyzer Temperature sensor #44 from distribution board position x44 ("NTC-POST", 11th connector from the left).

c) If (and ONLY if) screen 0's **Post Dialyzer** TEMP data box did NOT go to less that 34° C see procedure number CO- 10.2.0 (page 154).

d) CAREFULLY place the **6.04 KΩ** resistor plug, from the two-resistor OLC set, into X44's ("NTC-POST") vacant position.

e) Call debug screen 0. Is screen 0's **Post Dialyzer** TEMP data box reading between 36 and 38° C?

Yes See procedure number CO- 10.1.22 (page 153).

No
a) Assure the **6.04 KΩ** resistor plug is placed properly (at x44) BEFORE continuing! If not, return to procedure number CO- 10.1.0, part d.

b) CAREFULLY perform POST TEMPERATURE SENSOR calibration per procedure. If an "Operator Error" message occurs turn the machine off and repeat. If the message reoccurs, four possibilities: 1) Bad sensor cable; 2) Bad sensor board; 3) Bad function board; 4) Bad distribution board.

c) Perform TEMPERATURE CONTROL calibration per procedure.

CO- 10.1.22 CHECK OLC POST DIALYZER CONDUCTIVITY SENSOR (#13)

a) Referring to the Figure (above, right), unplug the Post Dialyzer Conductivity cell (#13) from distribution board position x13 (COND-POS", 10th connector from the left).

b) If (and ONLY if) screen 0's Post Dialyzer COND data box did NOT go to 0 return conductivity cell #13 to distribution board position x13, "COND-POS" then see procedure number CO- 10.2.0 (page 154).

c) Using a flashlight, CAREFULLY check inside the vacant x13 position for 'white' corrosion or damaged **male** pins that may cause false signals.

d) Place the **274 Ω** resistor plug, from the two-resistor OLC set, into position X13, "COND-POS".

e) Call debug screen 0. Is screen 0's **Post Dialyzer** COND data box reading between 13.0 and 14.5 mS?

Yes See procedure number CO- 10.3.0 (page 155).

No
a) Assure the **274 Ω** resistor plug is placed properly (at x13) BEFORE continuing! If not, repeat procedure number CO- 10.1.22, part d (page 153).

b) Return Conductivity cell #13 to distribution board position x13 ("COND-POS").

c) Return the Post-Dialyzer Temperature sensor #44 to position #44 ("NTC-POST").

d) Proceed to **page 145**, procedure number **CO- 6.0.0**.

CO- 10.2.0 CHECK SENSOR WIRING

a) Referring to Figure 309 (page 154), CAREFULLY trace the wiring cables from post dialyzer Conductivity sensor #13, AND Temperature sensor #44 to ASSURE they are plugged into the distribution board correctly.

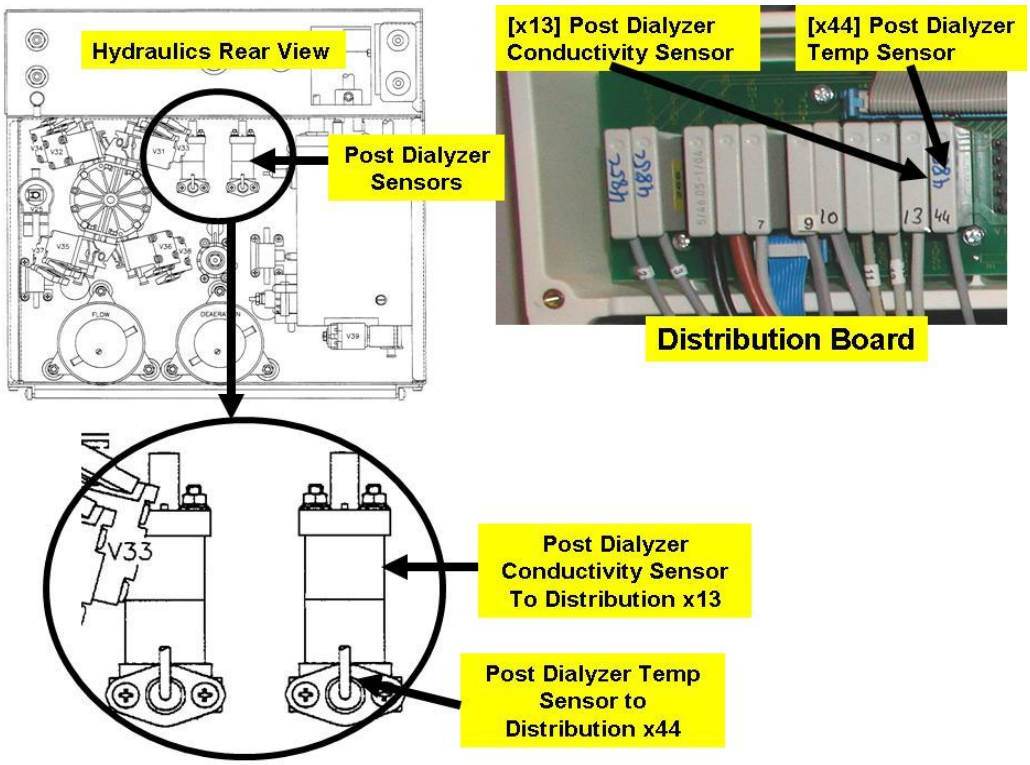

Hydraulics Rear View
Post Dialyzer Sensors
[x13] Post Dialyzer Conductivity Sensor
[x44] Post Dialyzer Temp Sensor
Distribution Board
V33
Post Dialyzer Conductivity Sensor To Distribution x13
Post Dialyzer Temp Sensor to Distribution x44

Figure 309 – OLC Components

b) Check the entire length of each sensor's wiring harness for insulation damage or extreme 'stickiness' (due to heat). **Replace the sensor if damage is located!**

c) Proceed accordingly (as noted in procedure number CO- 10.0.0):

- **Problem was noted with the Post Dialyzer COND sensor:** Proceed to **page 145**, procedure number **CO- 6.0.0**
- **Problem was noted with the Post Dialyzer TEMP sensor:** **CAREFULLY** perform POST TEMPERATURE SENSOR calibration per procedure. Does the "Operator Error" message occur?

  Yes CAREFULLY repeat the calibration and ASSURE the correct resistors are placed at distribution board position x44 as instructed! If the "Operator Error" message reoccurs, four possibilities: 1) Bad sensor cable; 2) Bad sensor board; 3) Bad function board; 4) Bad distribution board.

  No Return temperature sensor #44 to the distribution board. Return to Dialysis program, and allow eight minutes. Assure flow through the external flow indicator. From debug screen 0, if the Post Dialyzer data box is NOT greater than 34° C replace NTC #44 (see page 154).

CO- 10.3.0 CHECK OLC TEMPERATURE STABILITY

Call debug screen 5. CAREFULLY watch **TPOS** (Temperature post-dialyzer) for one minute. Note the highest and lowest values seen. Is highest minus lowest (highest - lowest) = 0 or 1?

Yes See procedure number CO- 10.3.1 (page 155).

No See procedure number CO- 10.4.0 (page 155).

CO- 10.3.1 CHECK OLC CONDUCTIVITY STABILITY

From debug screen 5, CAREFULLY watch **CPOS** (Conductivity post-dialyzer) for one minute. Note the highest and lowest value seen. Is highest minus lowest (highest - lowest) = less than 8?

Yes See procedure number CO- 10.5.0 (page 156).

No See procedure number CO- 10.3.2 (page 155).

CO- 10.3.2 CHECK FOR MOTOR NOISE

Call debug screen 3. Is **!ECH** AND/OR **!ACK** greater than 3?

Yes Turn the blood pump off then turn the machine off, back on and place it into Dialysis Program. Check **!ECH** and **!ACK** again. If remaining less than 3 replace the blood pump motor. If continuing to increase check the deaeration and flow motors for excessive carbon build up and/or bad brushes.

No See procedure number CO- 10.4.0 (page 155).

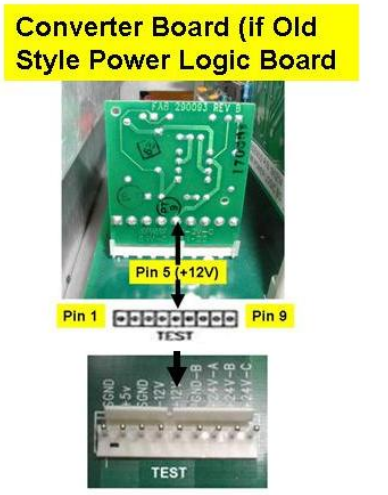
CO- 10.4.0 CHECK MOTOR NOISE / CHECK POSITIVE (+) 12 VOLT DC SUPPLY

a) Open the card cage. Place a volt meter's black lead on chassis ground (see Figure 1, page 3).\

b) Referring to Figure 60 (page 147), if the machine is equipped with ***old style power logic board*** it requires the '+12 to -12 Volt Converter Board'. This miniature circuit board uses the motherboard's TEST connector. If equipped with the ***new style power logic board*** (released 2008) the 'Converter' board is NOT required and should NOT be present (i.e. the TEST connector is empty).

c) Proceed accordingly to measure for +12 volts DC (see Figure right):

- ***Old style power logic board*:** Measure at the solder (rear) side of the 'Converter Board' at *pin 5* (five pins from the left) then see part d.
- ***New style power logic board*:** Measure directly at the empty TEST connector at *pin 5* (five pins from the left) then see part d.



d) Between +11.7 and +12.3 volts DC AND stable (i.e. does not vary more than +/- 0/1)?

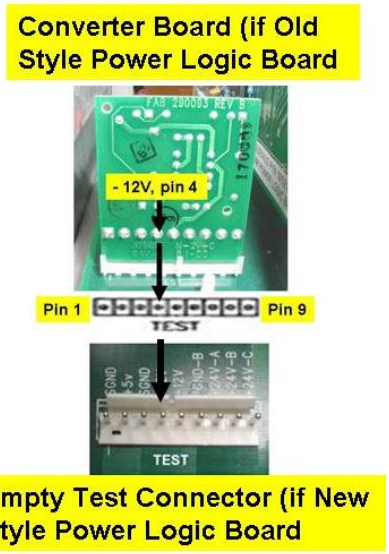
Yes See procedure number CO- 10.4.1 (page 156).

No Replace with a new style power logic board (assure the 'Convertor' board is NOT present) OR with an old style power logic board AND a 'Convertor' board [1, 2]

[1] **CAUTION!** To avoid damage, the 'Convertor' board MUST be installed with the 'solder side' towards the front of the machine AND matched exactly pin for pin to the TEST connector.

[2] If a +12 volt problem still exists after replacement proceed to **page** Error! Bookmark not defined., SECTION 24 – TROUBLESHOOTING POWER DISTRIBUTION.

CO- 10.4.1 CHECK NEGATIVE (-) 12 VOLT DC SUPPLY



a) Proceed accordingly to check -12 volts DC (see Figure right):

- ***Old style power logic board*:** Measure at the Converter board at *pin 4* (four pins from the left) then see part b.
- ***New style power logic board*:** Measure directly at the empty TEST connector at *pin 4* (four pins from the left) then see part b.

b) Between -11 and -13 volts DC AND stable (i.e. does NOT vary more than +/- 0.1)?

Yes Five possibilities: 1) Bad sensor cable; 2) Bad sensor board; 3) Bad function board; 4) Bad function board; 5) Bad distribution board.

No Proceed to **page 167**, procedure number **CR- 1.0.3**.

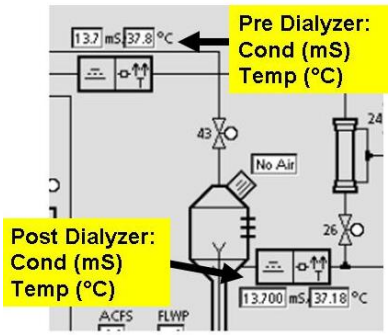
CO- 10.5.0 RETURN OLC SYSTEMS

a) Referring to Figure 309 (page 154), CAREFULLY return post-dialyzer conductivity cell #13 to distribution board position x13, "COND-POS".

b) CAREFULLY return post-dialyzer temperature sensor to distribution board position x44, "NTC-POST".

c) Call debug screen 0. Referring to the Figure (right), if BOTH sensors were placed properly the **Post Dialyzer** TEMP data box will read greater than 34°C **AND** the **Post Dialyzer** COND data box greater than 0 mS.

d) Call debug screen 5. **CPRE** and **ACOND** vary but overall do they remain within +/-100 of each other?



Yes See procedure number CO- 10.5.1 (page 156).

No Proceed to **page 145**, procedure # **CO- 6.0.0**.

CO- 10.5.1 CHECK POST DIALYZER CONDUCTIVITY

From debug screen 5, **CPRE** and **CPOS** vary but overall do they within +/- 500 of each other?

Yes See procedure number CO- 10.5.2 (page 156).

No Proceed to **page 145**, procedure number **CO- 6.0.0**.

CO- 10.5.2 CHECK CONDUCTIVITY STABILITY FACTORS

OLC requires temperature, conductivity and blood pump stability. At this point, prior troubleshooting procedures have determined that pre-dialyzer conductivity (cell #7) and Temperature (NTC #3) are stable.

a) Assure the shunt door is closed, the Bypass LED is OFF and flow through the external flow indicator.

b) From the Home screen, set Dialysate flow rate to where it is typically in your facility and clear ALL alarms.

c) If On-Line OR Manual OLC test was performed in the last minute instability is **NORMAL**. In this event, allow **two minutes** before continuing!

d) Call debug screen 1, if **NPHT** is less than 500 press and hold the "1" numeric keypad until **NPHT** is greater than 600. **Ignore an "On Line PHT Failed" message if it occurs**.

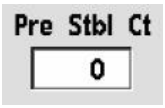
e) **IMPORTANT!** ALLOW **two minutes** for stabilization before continuing.

f) Call debug screen 5 (see below):

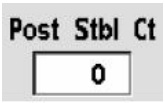
- **Pre Dev val** (pre-dialyzer deviation value) indicates the difference in conductivity now versus one minute ago as monitored by cell #7. It continually varies but if remaining less than 135 (0.135 mS) pre-dialyzer conductivity is stable enough to run OLC test

- **Post Dev val** (post-dialyzer deviation value) indicates the difference in conductivity now versus one minute ago as monitored by cell #13. It continually varies but if remaining less than 70 (0.070 mS) post-dialyzer conductivity is stable enough to run OLC test

- **Pre Stbl Ct** (pre-dialyzer stability counter) defaults to 90 and decrements if **Pre Dev val** is less than 135. When it reaches 0 the OLC test can start. **Pre Stbl Ct** increments towards 90 if **Pre Dev val** exceeds 135



- **Post Stbl Ct** (post-dialyzer stability counter) defaults to 70 and decrements if **Post Dev val** is less than 70 mS. When it reaches 0 the OLC test can start. **Post Stbl Ct** increments towards 70 if **Post Dev val** exceeds 70



g) Is **Pre Dev val** greater than 135 **OR Post Dev val** greater than 70?

Yes See procedure number CO- 10.5.3 (page 157).

No See procedure number CO- 10.5.4 (page 157).

CO- 10.5.3 CHECK 'ACTUAL' CONDUCTIVITY STABILITY

a) Call debug screen 1, if **NPHT** is less than 600 press and hold the "1" numeric keypad until **NPHT** is greater than 600. **Ignore an "On Line PHT Failed" message if it occurs**.

b) Place a calibrated external meter into the dialysate lines, close the shunt door, and allow two minutes for the meter reading to stabilize.

c) Watch the meter's: **1)** Temperature and then; **2)** Conductivity EACH for **one minute**. Note the highest and lowest values. Three possible scenarios:

1. **If (and ONLY if) Temperature is unstable (i.e. varies greater than 0.15° C):** Proceed to page 92, SECTION 4 – TEMPERATURE PROBLEMS
2. **If (and ONLY if) Conductivity is unstable (i.e. varies greater than 0.070 mS):** Proceed to **page 142**, procedure number **CO- 5.0.0**.
3. **If (and ONLY if) Temperature AND Conductivity are stable:** See procedure number CO- 10.5.4 (page 157).

CO-10.5.4 PERFORM MANUAL OLC TEST

a) Place the dialyzer quick connectors into the shunt and **IMPORTANT!** Close the door.

b) Call debug screen 6 and allow **Count** to reach 0 (if not already = 0).

c) Call the Kt/V window and perform the Manual OLC test. If the test won't start ("Can't Run OLC Test") allow one minute then try again. If it still won't start turn the machine off then return to Dialysis program. Allow five minutes for stabilization and perform the Manual OLC test.

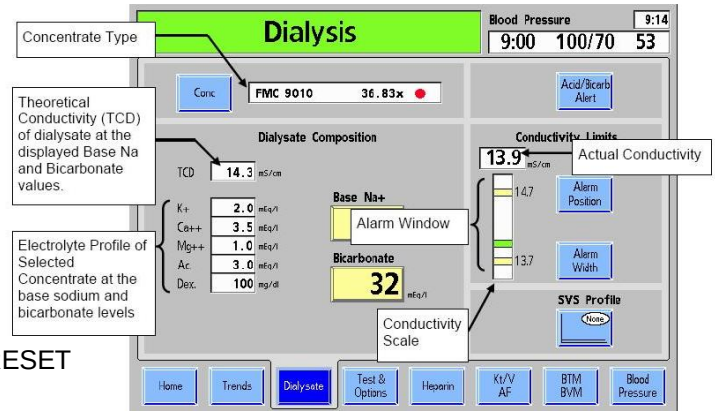
d) Allow the Manual OLC test to complete (between 8 and 16 minutes).

e) See procedure number CO- 10.7.0 (page 158).

CO- 10.7.0 ADDITIONAL OLC TROUBLESHOOTING

If OLC tests are consistently cancelling during a treatment:

1. Press the 'Dialysate' button. From the 'CONFIRM Concentrate' screen (see Figure right), ASSURE the **Concentrate Type** matches what is connected to the machine.
2. Assure Base Na+ and Bicarbonate levels are per a typical treatment.
3. Assure the Conductivity alarm limits are/were centered.
4. Blood alarms during OLC test should be RESET immediately.



5. Assure **TCD** and 'Actual Conductivity' is within +/- 0.3 mS of each other. If (and ONLY if) they are NOT within +/- 0.3 of each other:
   a) Before continuing, ASSURE the concentrate is fresh and mixed properly (especially the bicarbonate)! **Good concentrate is CRITICAL!**
   b) Assuming it is KNOWN that the concentrate is good, see procedure number CO- 8.0.6 (page 150).
6. All treatment parameters (see below) should be reset and/or entered prior to the beginning each treatment. Changing parameters after the treatment has begun or during an OLC test may cause cancelation and/or inaccurate results:

- Remaining Time Of Dialysis (RTD)
- UF Goal
- Fluid Removed (UF Removed)
- Sodium Variation (SVS, if used) should be activated just after UF is turned on
- Dialysate Flow Rate
- Blood Flow Rate
- Temperature
- Concentrate (bath)
- Na+ and Bicarbonate settings

7. Call debug 6. Refer to Table A (page 159). NOTE: Screen 6 data is useful to determine why an OLC test cancels during a treatment. **NOTE: Some of this data is no longer available after the machine has been turned off.**
8. Call debug screen 5 then refer to Table B (page 160).

Table A - Debug Screen 6 OLC Values

Parameter	Description	Value
Pos-Start	Post dialyzer conductivity at the start of OLC test	Depends on dialysate selections
Pre-Start	Pre dialyzer conductivity at the start of OLC test	Depends on dialysate selections
Max QBS (Blood pump stability)	Maximum QbS during OLC test	Less than 20 indicates stable blood pump rate. If greater than 20 the OLC test cancels. See also QB Cancel and OLC Cancels.
QD Begin	Dialysate flow at beginning of OLC test	Should be within 10 ml/min of selected Dialysate flow rate when the test started. See also QD Cancel and OLC Cancels.
QD End	Dialysate flow at end of OLC test	Should be within 10 ml/min of selected Dialysate flow rate when the test ended. See also QD Cancel and OLC Cancels.
QD Cancel	Dialysate flow when OLC test was canceled	If not within 10 ml/min of QD Dialysate flow rate changed during the OLC test. See also QD Cancel and OLC Cancels.
QB Cancel	Blood flow when OLC test was canceled	If blood pump speed changed during the OLC test the OLC test cancels. See also OLC Cancels.
OLC Cancels 1- 6 		1 – Unable to reach or stabilize at the upper conductivity level (15.5 mS [1]) 2 – Unable to reach or stabilize at the lower conductivity level (approximately 13.5 mS [2]) 3 – Blood pump stability greater than 20 (see also QbS, screen 5) 4 – Dialysate flow unstable (see also QdS, screen 5) 5 – OLC test disabled 6 – Dialysate flow was turned off 7 – OLC test started

[1] During OLC test Conductivity ramps up from base conductivity to 15.5 mS.

[2] After achieving 15.5 mS Conductivity ramps down to 13.5 mS unless the base conductivity is less than 13.5. In this event it ramps down to the base conductivity.

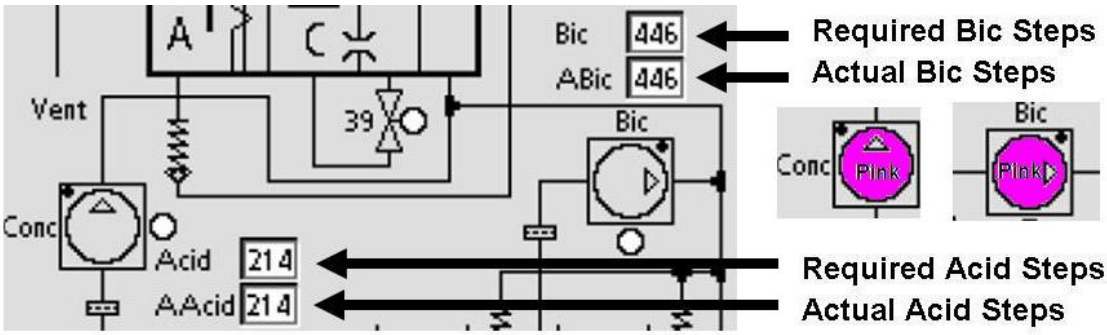
NOTE: Changing Dialysate flow rate, or turning it off, Filling Programs, Pressure Tests and Temperature or Conductivity alarms (i.e. bypass) affect Table B readings. ASSURE the machine is stable before responding to variations!

Table B – Debug Screen 5 OLC Values

Parameter	Description	Value
Qd	Dialysate Flow Rate	Should be within +/- 10 ml/min of the selected Dialysate flow rate
QdS	Dialysate Flow Stability	0 – Dialysate flow is unstable 1 – Dialysate flow is stable. May = 0 if bypass occurs, if Dialysate flow is changed, or Filling Program occurs.
Current TI	Temperature sensor NTC-3 (pre-dialyzer) stability	Ranges from 0 (unstable) to 100 (very stable)
QbS	Blood Pump Stability Counter	Normally 0 to 1. If QbS reaches 20, the OLC test will not start or will cancel
Avg TI	Pre-dialyzer temperature stability over the last 12 minutes	Should be greater than 70 when the machine is stable at a **dialysate flow of 500 ml/min**. May be lower at other flow rates.
Pre Dev val (value)	Conductivity Cell #7 (pre-dialyzer) stability	Upper limit is 135 (0.135 mS) when OLC test is NOT running. If the OLC test is ramping conductivity up or down Pre Dev val will NOT be stable
Pre Stbl Ct (Counter)	Conductivity Cell #7 counter	Defaults to 90. Must count down to 0 before pre-dialyzer conductivity (cell #7) is ready for OLC
Pre % Stbl (Stable)	Percentage of time pre dialyzer conductivity (cell #7) is stable over the last 12 minutes	If OLC test is NOT running should be greater than 90%. Instability is normal within 12 minutes of an OLC test.
Post Dev val (value)	Conductivity Cell #13 (post-dialyzer) stability	Upper limit is 70 (0.070 mS) when OLC test is NOT running. If the OLC test is ramping conductivity up or down conductivity Post Dev val will NOT be stable
Post Stbl Ct (Counter)	Conductivity Cell #13 counter	Defaults to 70. Must count down to 0 before post-dialyzer conductivity (cell #13) is ready for OLC
Post % Stbl (stability)	Percentage of time post dialyzer conductivity (cell #13) is stable over the last 12 minutes	If OLC test is NOT running should be greater than 90%. Instability is normal within 12 minutes after an OLC test.
OLC status	Current stage of OLC test	0 – OLC not running 1 – At the upper conductivity level (approx. 15.5 mS) 2 – At the lower conductivity level
OLC Enable	OLC Enabled	0 – If OLC is disabled from the Options screens 1 – If OLC is enabled from the Options screens
CPRE Stable	Pre-dialyzer conductivity when stable during OLC test	Not applicable unless OLC (on Line or Manual) were not performed previously
CPOS Stable	Post-dialyzer conductivity when stable during OLC test	Not applicable unless OLC (on Line or Manual) were not performed previously

SECTION 6 – CONCENTRATE PUMP (EOS) ERRORS

The concentrate pumps incorporate optical sensors to monitor movement of their diaphragm assembles as transported by stepper motors. If the 'actual number of steps' is not within +/- 5 of the 'required number of steps' an EOS error occurs causing the pump's (debug screen 0) symbol to turn pink. See procedure number EOS- 1.0.0 (page 165).



EOS- 1.0.0 DETERMINE THE EOS ERROR

a) **IMPORTANT!** If not already done, perform INITIAL CHECKS (page 6).

b) Call debug screen 0. Ignore the screen's initial transition as the pump symbols may appear 'pink'. Proceed as directed below:

- **CONC (acid)** **symbol is pink (solid or blinking) AND the BIC** **symbol is white:** The ACID pump is issuing an EOS error and the BIC pump is good. See procedure number EOS- 2.0.0 (page 161).
- **CONC (acid)** **symbol is white AND the BIC symbol** **is pink (solid or blinking):** The BIC pump is issuing an EOS error and the acid pump is good. See procedure number EOS- 3.0.0 (page 162).
- **BOTH the CONC (acid)** **AND the BIC** **symbols are pink (solid or blinking):** See procedure number EOS- 5.0.0 (page 164).
- **BOTH pump symbols remain white:** A pump error is not present. Manually monitor **Acid** versus **AACl** and **Bic** versus **ABic** to assure they are remaining within +/- 5 of each other. If (and ONLY if) they are not, two possibilities: 1) Bad pump; 2) Bad actuator board.

EOS- 2.0.0 CHECK THE CONC (ACID) PUMP

This procedure uses the bicarbonate pump (known good) to check the acid pump.

a) **IMPORTANT! Turn the machine off to prevent damage!**

b) Referring to Figure 63 (page 162), unplug the acid pump's ribbon cable from distribution board position P16, "CONC-P". **Be CAREFUL to avoid the (optional) Heparin pump!**

c) Using a flashlight, check **inside** the vacant "P16" position for 'white' corrosion or damaged **male** pins that may cause false signals. Damage may indicate that the distribution board needs to be replaced.

d) CAREFULLY plug the bicarbonate pump's ribbon cable into the acid pump's position P16, "CONC-P". **The connector should insert easily if the pins are okay!**

e) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

f) Wait one minute then call debug screen 0. **Ignore the BIC symbol!** Is the CONC symbol **pink** (solid or blinking) or **white**?

Pink The acid pump is okay. See procedure number EOS- 4.0.0 (page 163).

White The acid pump may be bad:

a) **IMPORTANT!** Turn the machine off to prevent damage and CAREFULLY return the bicarbonate pump to distribution board position P17, "BIC-P".

b) Referring to Figure 63 (page 162), assure the acid pump is mounted with its output nozzle towards the top and the ribbon cable extending from the side. If okay, replace the acid pump.

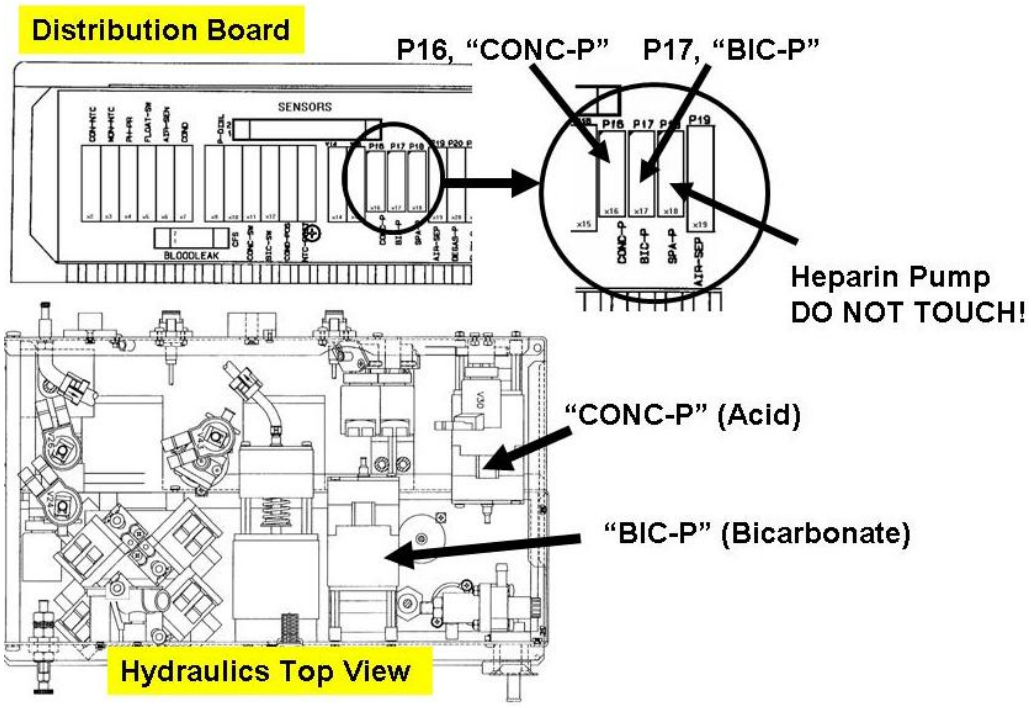


Figure 63 – Distribution Board / Hydraulics Top View (Pumps)

EOS- 3.0.0 CHECK THE (BIC) BICARBONATE PUMP

This procedure uses the acid pump (known good) to check the bicarbonate pump.

a) **IMPORTANT! Turn the machine off to prevent damage!**

b) Referring to Figure 63 (page 162), unplug the bicarbonate pump's ribbon cable from distribution board position P17, "BIC-P". **Be CAREFUL to avoid the (optional) Heparin pump!**

c) Using a flashlight, check **inside** the vacant "P17" position for 'white' corrosion or damaged **male** pins that may cause false signals. Damage may indicate that the distribution board needs to be replaced.

d) CAREFULLY plug the acid pump's ribbon cable, from position P16, "CONC-P", into the bicarbonate pump's position (P17, "BIC-P"). **The connector should insert easily if the pins are okay!**

e) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

f) Wait one minute then call debug screen 0. **Ignore the CONC symbol!** Watch for one minute. Is the BIC symbol **pink** (solid or blinking) or **white**?

Pink The bicarbonate pump is okay. See procedure number EOS- 4.0.0 (page 163).

White The bicarbonate pump may be bad.

a) **IMPORTANT!** Turn the machine off to prevent damage and CAREFULLY return the acid pump to distribution board position P16, "CONC-P".

b) Referring to Figure 63 (page 162), assure the bicarbonate pump is mounted with its output nozzle towards the top and the ribbon cable extending from its side. If okay, replace the bicarbonate pump.

EOS- 4.0.0 CHECK CONCENTRATE PUMP CIRCUIT

a) **IMPORTANT!** Turn the machine off to prevent damage.

b) Referring to Figure 63 (page 162), CAREFULLY return both pumps to their distribution board positions (i.e. Acid pump to P16, "CONC- P"; Bicarbonate pump to P17, "BIC-P").

c) Five possibilities: 1) Bad actuator board; 2) Bad sensor cable; 3) Bad actuator cable; 4) Bad distribution board; 5) Bad motherboard.

1. Actuator Board (see Figure 4A, page 8):

a) **IMPORTANT!** Turn the machine off and swap in a known good actuator board.

b) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

c) Allow one minute then call debug screen 0. Is the pump's symbol remaining white?

Yes Problem solved! The previous actuator board is bad.

No Continue with EOS- 4.0.0, step #2 (the previous actuator board is okay).

2. Sensor Cable (see Figure 4A, page 8):

a) **IMPORTANT!** Turn the machine off and swap in a known good sensor cable (or check[1] the sensor cable).

[1] To check the sensor cable. Which pump is issuing the EOS error?

ACID: **NOTE** that one (1) ACID EOS connection will be checked and proceed to page 228, SECTION 17- CHECKING THE SENSOR BOARD CABLE. If the sensor cable checks good continue with EOS- 4.0.0, step #3.

BICARB: **NOTE** that one (1) BICARB EOS connection will be checked and proceed to page 228, SECTION 17 - CHECKING THE SENSOR BOARD CABLE. If the sensor cable checks good continue with EOS- 4.0.0, step #3.

b) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

c) Allow one minute then call debug screen 0. Is the pump's symbol remaining white?

Yes Problem solved. The previous sensor cable was bad

No Continue with EOS- 4.0.0, step #3 (the previous sensor cable is good).

3. Actuator Cable (see Figure 4A, page 8):

a) **IMPORTANT!** Turn the machine off and swap in a known good actuator cable (or check[2] the actuator cable).

[2] To check the actuator cable. Which pump issuing the EOS error?

ACID: **NOTE** that four (4) ACID PUMP connections will be checked and proceed to page 225, SECTION 16 - CHECKING THE ACTUATOR BOARD CABLE. If the actuator cable checks good continue with EOS- 4.0.0, step #4.

BICARB: **NOTE** that four (4) BICARB PUMP connections will be checked and proceed to page 225, SECTION 16 - CHECKING THE ACTUATOR BOARD CABLE. If the actuator cable checks good continue with EOS- 4.0.0, step #4.

b) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

c) Allow one minute then call debug screen 0. Is the pump's symbol remaining white?

Yes Problem solved! The previous actuator cable was bad.

No Continue with EOS- 4.0.0, step #4 (the previous actuator cable is good).

4. **Distribution Board or Motherboard:** If you are absolutely sure that all of the above checks have been performed correctly, two possibilities: 1) Bad distribution board; 2) Bad motherboard.

EOS- 5.0.0 ACID AND BICARB ERROR

a) Referring to Figure 63 (page 162), assure that both pumps are mounted with their output nozzle towards the top and their cables extending from the side.

b) **IMPORTANT!** Turn the machine off to prevent damage!

c) Swap in a known good actuator board (see Figure 4A, page 8)

d) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

e) Allow one minute then call debug screen 0. Do BOTH pump symbols REMAIN white?

Yes The previous actuator board is bad.

No The previous actuator board is good. See procedure number EOS- 5.0.1 (page 164).

EOS- 5.0.1 CHECK THE PUMPS

a) **IMPORTANT!** Turn the machine off to prevent damage!

b) Referring to Figure 63 (page 162), plug in a known good pump into distribution board position "P16" (acid pump).

c) Place the machine into Dialysis program (remember to press the 'CONFIRM' key) and allow one minute.

d) Call debug screen 0. Does the acid pump symbol = white?

Yes Repeat from procedure number EOS- 5.0.1, step a, for the bicarbonate pump ("P17").

No Four possibilities (see Figure 4A, page 8): 1) Bad actuator cable; 2) Bad sensor cable; 3) Bad distribution board; 4) Bad mother board

SECTION 7 - COND REF FAILURE OR COND OFFSET FAILURE

CR- 1.0.0 CHECK DISTRIBUTION BOARD

a) Referring to the Figure 320 (page165) inside the distribution board (two checks)

1) ASSURE position x4 "PH-PR" (3rd position from the left) is **EMPTY! If not, this may be the problem!**

2) ASSURE the Power Ground (PGND) wire is plugged in securely. **If not this may be the problem!**

b) See procedure number CR- 1.0.1 (page 165).

Figure 320 - Distribution Board

CR- 1.0.1 CHECK POSITIVE (+) 12 VOLT DC SUPPLY

a) Open the card cage.

b) Place a volt meter's black lead at chassis ground (see Figure 1, page 3).

c) ASSURE the machine is on! **Ignore any alarms for now!**

d) Referring to Figure 64 (page166), if the machine is equipped with the ***old style power logic board*** the '+12 to -12 volt Converter Board' IS required. This miniature circuit board uses the motherboard's TEST connector. If equipped with the ***new style power logic board*** (released 2008) the TEST connector is empty as the -12 volt supply is incorporated on the board. In this event, the 'Converter' board should NOT be used.

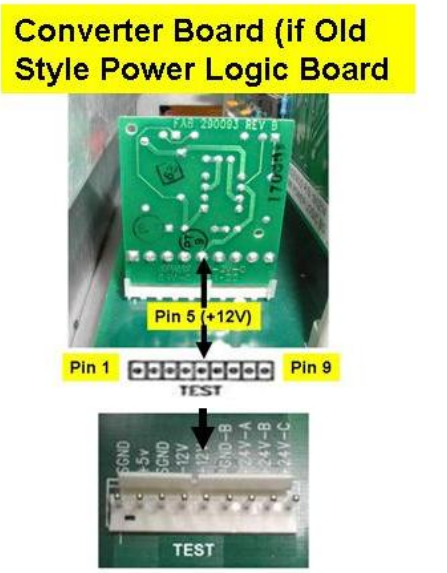
e) Proceed accordingly to check for +12 volts DC (see Figure (right):

- ***Old style power logic board*:** Measure at the solder (rear) side of the 'Converter Board' at *pin 5* (five pins from the left) then see part f.
- ***New style power logic board*:** Measure directly from the empty TEST connector at *pin 5* (five pins from the left) then see part f.

f) Between +11.7 and +12.3 volts DC?

Yes See procedure number CR- 1.0.2 (page 166).

No Replace the power logic board (see Figure 4A and NOTE B, page 8). If (and ONLY if) the problem still exists (bad +12 volts) after board replacement proceed to **page** Error! Bookmark not defined., SECTION 24 – TROUBLESHOOTING POWER DISTRIBUTION



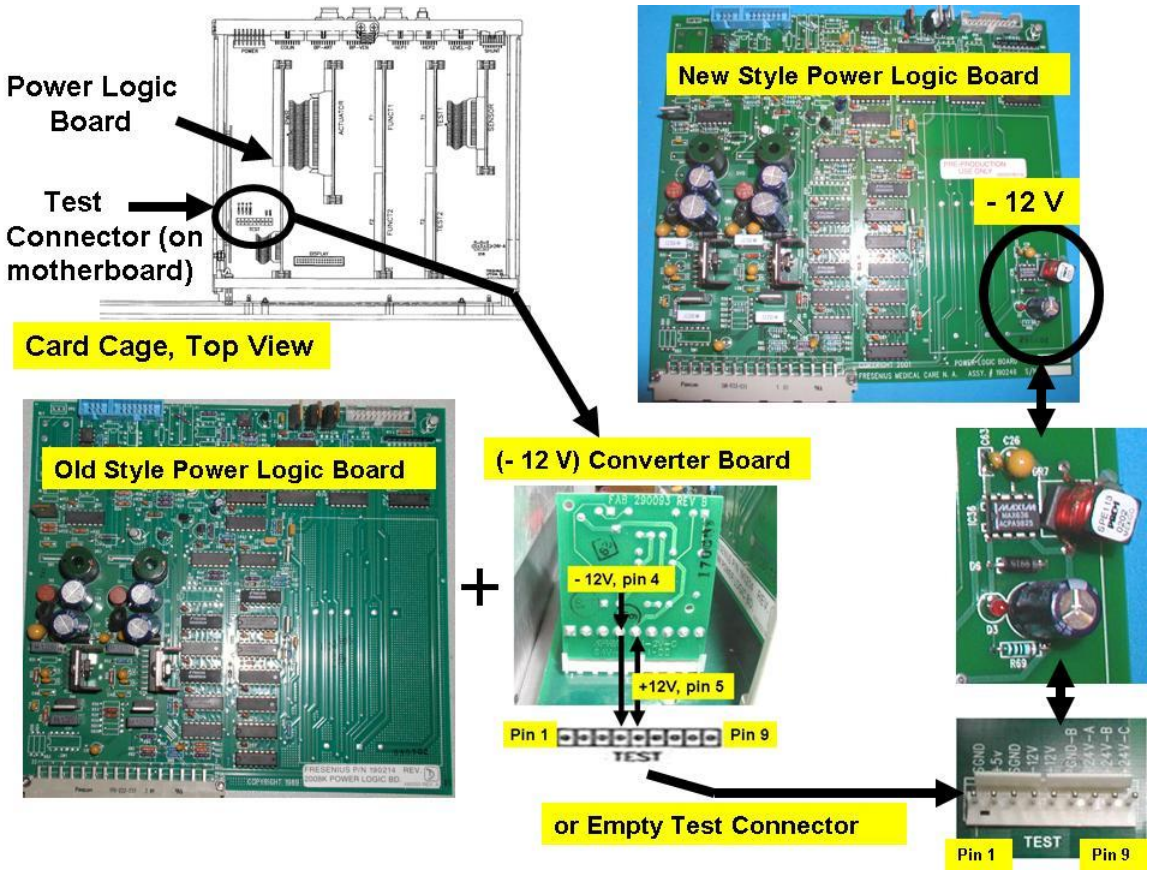


Figure 64 – Power Logic Board

CR- 1.0.2 CHECK NEGATIVE (-) 12 VOLT DC SUPPLY

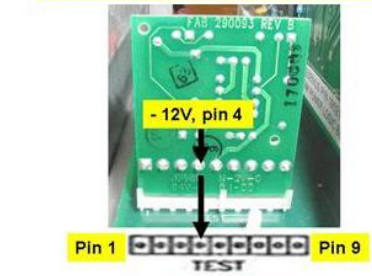
a) Proceed accordingly (depending on how the machine is equipped (see Figure right)

- ***Old style power logic board*:** Measure at the solder (rear) side of the Converter board at *pin 4* (four pins from the left) then see part b
- ***New style power logic board*:** Measure directly at the empty TEST connector, *pin 4* (four pins from the left) then see part b

b) Between -11 and -13 volts DC AND stable (i.e. does not vary more than +/- 0.1)?

Yes See procedure number CR- 1.0.4 (page 167).

No See procedure number CR- 1.0.3 (page 167).



CR- 1.0.3 IDENTIFY PROBLEM

Machine is equipped with (proceed accordingly):

- **Old style power logic board:** Replace the Convertor[1] board with a known good or with a known good new style power logic board and remove the Convertor board [1, 2, 3]
- **New style power logic board:** Replace with a known good new style power logic board [1] OR with a known good old style power logic board AND Convertor board [1, 2, 3].

[1] **CAUTION! To avoid damage, the 'Convertor' board MUST be installed with the 'solder side' towards the front of the machine AND matched exactly pin for pin to the TEST connector**.

[2] If -12 volts remains unstable turn the blood pump off and check if the problem still exists. Check the deaeration and flow motors for excessive carbon build up and bad brushes.

[3] If the problem still exists proceed to **page** Error! Bookmark not defined., SECTION 24 – TROUBLESHOOTING POWER DISTRIBUTION

CR- 1.0.4 VERIFY COND ERROR

COND errors may occur if sensor and/or function board or function board EEPROM (IC2) been 'swapped in' or replaced. Have any of these components been swapped in recently?

Yes If 'swapping' these components for troubleshooting purposes enter Service Mode → Options → Hardware Options. Select "Yes" for T and C (Test and Calibration). Press the 'CONFIRM' key (the 'x' turns blue). This defeats Conductivity error messages and allows the machine to run without performing the Cond Cells calibration.

No See procedure number CR- 1.0.5 (page 167).

CR- 1.0.5 ISOLATE THE TEST BOARD

NOTE: If (and ONLY if) the machine is equipped with the new-style combination actuator/test board (see Figure 4A AND NOTE C, page 8) skip to procedure number CR- 1.0.6 (page 167)

Turn the machine off and swap in a known good test board (see Figure 4A, page 8). Does the error reoccur?

Yes The previous test board is okay. See procedure number CR- 1.0.6 (page 167).

No The previous test board is bad.

CR- 1.0.6 ISOLATE THE ACTUATOR BOARD

Turn the machine off and swap in known good actuator board or actuator/test board (see Figure 4A AND NOTE C, page 8). Does the error reoccur?

Yes The previous actuator board is okay. See procedure number CR- 1.0.7 (page 167).

No The previous actuator board is bad.

CR- 1.0.7 TROUBLESHOOT OFFSET ERRORS

a) Read this entire step! Attempt Conductivity Cells calibration per procedure. If unsuccessful, continue to CR- 1.0.6, part b.

b) Swap the following components, one at a time, with known good attempting Conductivity Cells calibration in between (see Figure 4A, page 8): 1) Sensor board; 2) Function board EEPROM (IC2); 3) Function board.

SECTION 8 - FILLING PROGRAM PROBLEMS

Filling Programs are caused by air that is 'captured' in Air Removal Chamber #69. They purge air out of the hydraulics via valve #43. Messages include "Filling Program", "10 Fill Pgm in 1 Hr" (probably a large air leak) and "Filling Program Alarm" (probably a hardware failure).

A) ASSURE the vent tubing (see Figure 6, page 13) is not pinched or clamped.

B) ASSURE the drain tubing is no more than three feet above the floor and should NEVER be inserted so that its opening is submersed.

C) Assure the external flow indicator (#75) is vertical (see Figure right)! **If not this may cause Filling Programs**.

D) **IMPORTANT!** If Automated Tests start (screen reads "Test …") at ANY time allow them to complete! Automated Testing, while troubleshooting, may cause misdiagnosis! IGNORE all test fail messages for now!

E) See procedure number FIL- 1.0.0 (page 168).

FIL- 1.0.0 CHECK FOR LARGE HYDRAULIC FLUID LEAKS

a) Referring to the Figure (right), dripping from the vent tubing is normal with prolonged Filling Programs. **If occurring, ignore it for now!**

b) Check inside the hydraulic compartment and the DiaSafe® filter (if equipped). Is a large external water leak located?

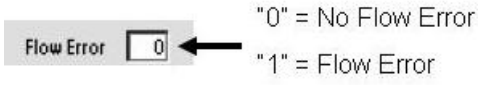
Yes Close the shunt door and proceed to **page 248**, SECTION 21- LARGE HYDRAULIC LEAKS.

No See procedure number FIL- 1.0.1 (page 168).

FIL- 1.0.1 CHECK FLOW ERROR

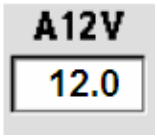
a) **IMPORTANT!** Open the shunt door and leave it open until instructed otherwise.

b) Call debug screen 0 and CAREFULLY watch **Flow Error** for **two minutes** or until if **Flow Error** = 1. Proceed accordingly:



- **Flow Error = 0 (constant):** See procedure number FIL- 1.0.2 (page 168).
- **Flow Error = 1 (constant or intermittent):** Close the shunt door and proceed to **page 14**, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM.

FIL- 1.0.2 CHECK +12 VOLTS (A12V)



From debug screen 4, is **A12V** (right column) between 11.5 and 12.5 volts AND stable (i.e. does NOT vary greater than +/- 0.1)?

Yes See procedure number FIL- 1.0.3 (page 168).

No See procedure number FIL- 1.0.4 (page 169).

FIL- 1.0.3 CHECK +5 VOLT (5V)

Call debug screen 4. Is **5 V** (left column) between 4.7 and 5.3 volts AND stable?

Yes See procedure number FIL- 1.0.5 (page 169).

No See procedure number FIL- 1.0.4 (page 169).

FIL- 1.0.4 VERIFY VOLTAGE PROBLEM

Proceed accordingly:

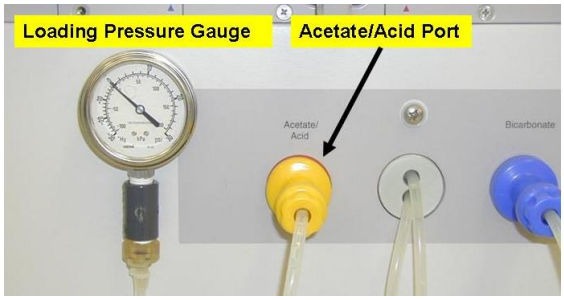
- **Voltage STABLE but not within the specified range:** Perform VOLTAGE DETECTION CALIBRATION. If (and ONLY if) unsuccessful, replace the power logic board (see Figure 4A and NOTE B, page 8). If (and ONLY if) the problem still exists (bad +12 or +5 volts) after board replacement proceed to **page** Error! Bookmark not defined., SECTION 24 – TROUBLESHOOTING POWER DISTRIBUTION.
- **Voltage is UNSTABLE:** Call debug screen 3. Is **!ECH** AND/OR **!ACK** greater than 3?

  Yes Turn the blood pump off then turn the machine off, back on and place it into Dialysis Program. Check **!ECH** and **!ACK** again. If remaining less than 3 replace the blood pump motor. If continuing to increase check the deaeration and flow motors for excessive carbon build up and/or bad brushes.

  No Replace the power logic board (see Figure 4A and NOTE B, page 8). If (and ONLY if) the problem still exists (unstable +12 or +5 volts) after board replacement proceed to **page** Error! Bookmark not defined., SECTION 24 – TROUBLESHOOTING POWER DISTRIBUTION.

FIL- 1.0.5 CHECK LOADING PRESSURE

a) ASSURING the loading pressure gauge reads 0 psi before inserting it, **SLAM** it into the red Acetate/Acid rinse port (see Figure right).



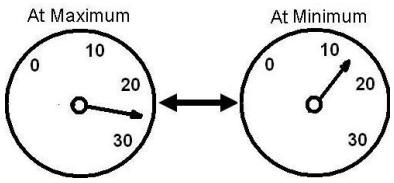
b) Per Table G (page 169), pressure MUST be **fluctuating** to its maximum **AND** NEVER dropping below the minimum. CAREFULLY watch BOTH levels for two minutes. Is loading pressure okay?

  Yes See procedure number FIL- 1.0.6 (page 169).

  No Proceed to **page 18**, procedure number **F- 2.0.4**.

Table G

DiaSafe® filter?	Maximum:	Minimum (no lower than):
Yes	23 – 25 psi	15 psi
No	18 – 20 psi	11 psi

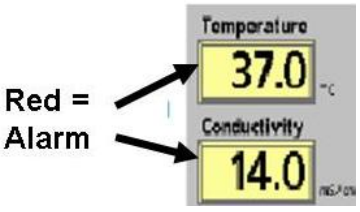


FIL- 1.0.6 CHECK 'OUT OF BYPASS' FLOW

a) Call the Home screen. Watch **Temperature** and **Conductivity** for one minute. Two checks:

  1) **Temperature** MUST be between 35.5 and 38.5° C AND does not vary more than +/- 0.15° C. **The Temperature window MUST NOT be RED!**

  2) **Conductivity** MUST be between 13.0 and 14.5 mS AND does not vary greater than +/- 0.2 mS. **If the Conductivity window is red adjust the conductivity alarm limits.**



b) **IMPORTANT!** Close the shunt door!

c) From the Home screen, set Dialysate to 500 ml/min (NOT "a500") and press the 'CONFIRM' key.

d) **IMPORTANT!** Do NOT reset alarms!

e) **IMPORTANT!** With the Bypass LED (front panel) OFF (constant) is the 'bob' inside the external flow indicator (#75) rising (at least ¼ up) and falling?

Yes See procedure number FIL- 2.0.0 (page 170).

No a) **ASSURE** that neither the **Temperature** nor **Conductivity** window is RED!

b) If (and ONLY if) Dialysate flow is NOT set to 500 ml/min (NOT "a500") repeat FIL- 1.0.5 (page 169) from part e.

c) Proceed to **page 14**, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM.

FIL- 2.0.0 CHECK FILACT (Filing Program Active?)

Call debug screen 1 and watch **FILACT** for one minute.

= 1 (constant or intermittent): See procedure number FIL- 3.0.0 (page 170).

= 0 (constant): Filling Program is not occurring. See procedure number FIL- 5.0.0 (page 174).

FIL- 3.0.0 CHECK ON-LINE CLEARANCE COMPONENTS

Referring to Figure 65 (page 170), IF the machine Online Line Clearance (OLC) equipped, both the 'pre-dialyzer' and 'post-dialyzer' conductivity and temperature sensors are installed. Is the machine OLC equipped?

Yes See procedure number FIL- 3.0.1 (page 171).

No See procedure number FIL- 3.0.3 (page 171).

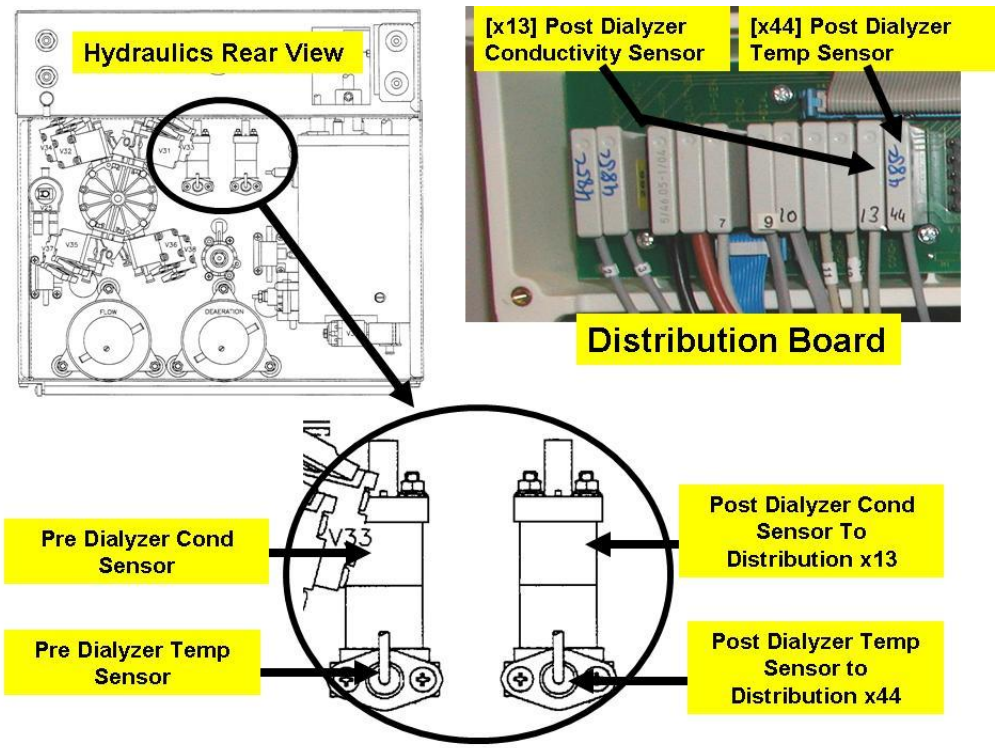
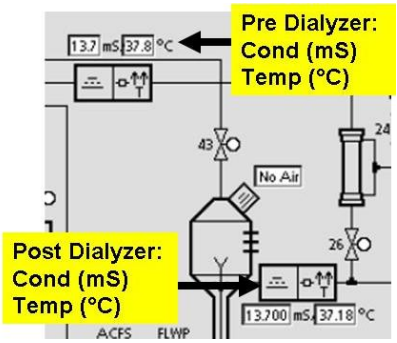

Hydraulics Rear View
[x13] Post Dialyzer Conductivity Sensor
[x44] Post Dialyzer Temp Sensor
Distribution Board
V33
Pre Dialyzer Cond Sensor
Pre Dialyzer Temp Sensor
Post Dialyzer Cond Sensor To Distribution x13
Post Dialyzer Temp Sensor to Distribution x44

Figure 65 – OLC Components

FIL- 3.0.1 CHECK OLC SENSORS



a) Call debug screen 0. Referring the Figure (right), if (and ONLY if) the Post Dialyzer Cond and Temp sensors do NOT appear skip to FIL- 3.0.2 (page 171).

b) Are 'pre and post-dialyzer' Temp values within 1.2 of each other?

Yes See procedure number FIL- 3.0.3 (page 171).

No See procedure number FIL- 3.0.2 (page 171).

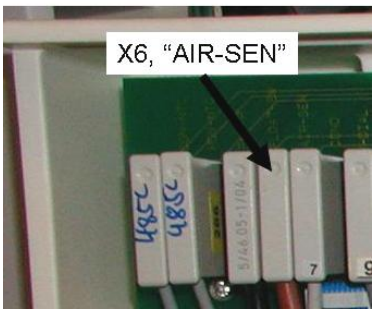
FIL- 3.0.2 CHECK OLC SENSOR CONNECTORS/ CABLES

Referring to Figure 65 (page 170), reversed connectors x13 (post dialyzer cond cell) and x44 (post dialyzer temp sensor) will cause Filling Programs. CAREFULLY trace each cable from the distribution board to the sensors inside the hydraulics. Check also for insulation damage! Are they reversed or damaged?

Yes Plug them in correctly (if reversed) or replace them (if the insulation is damaged) then see procedure number FIL- 3.0.8 (page 173).

No See procedure number FIL- 3.0.3 (page 171).

FIL- 3.0.3 CHECK AIR SENSOR #6 ELECTRICAL CONNECTIONS



a) Referring to the Figure (right), assure the air sensor connector is plugged into distribution board position labeled "AIR-SEN".

b) Referring to Figure 66 (page 171), assure the wire harness from "AIR-SEN" terminates at the male probes on top of chamber #69. **The brown wire should be at the top!**

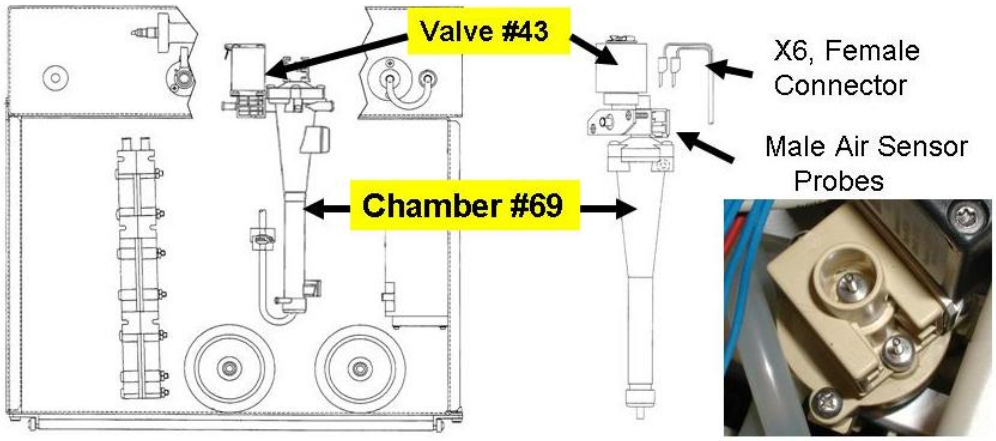
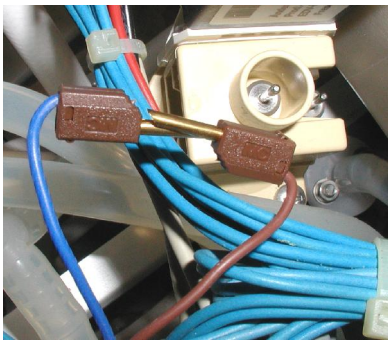


Figure 66 – Hydraulics (Front View)



c) From debug screen 1, continue ONLY if **FILACT** = 1. **Reseating connectors may have remedied the problem!**

d) Referring to the Figure (right) and **without pulling on the wires** remove both female connectors from the male probes and connect them snug together. This simulates 'no air in chamber #69'. **Leave them connected together until instructed otherwise!**

e) **IMPORTANT!** Allow 30 seconds. **FILACT** response is NOT instantaneous.

f) From debug screen 1, does **FILACT** = 0 constant?

Yes See procedure number FIL- 3.0.4 (page 172).

No After 30 seconds, If **FILACT** still = 1, see procedure number FIL- 3.2.0 (page 173).

FIL- 3.0.4 CHECK FOR MASKED FLOW ERROR

Filling Programs can mask Flow Errors. This procedure assures that a Flow Error is not present when **FILACT** = 0.

a) Re-check loading pressure. If (and ONLY if) it is NOT peaking to between: 23 and 27 psi (equipped with DiaSafe® filter); 17 and 23 psi (NOT equipped with DiaSafe® filter) proceed to **page 18**, procedure number **F- 2.0.4**.

b) Call debug screen 0 and CAREFULLY watch **Flow Error** for **two minutes** or until if **Flow Error** = 1. Proceed accordingly:

- **Flow Error = 0 (constant):** See procedure number FIL- 3.0.5 (page 172).
- **Flow Error = 1 (constant or intermittent):** Proceed to **page 14**, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM.

FIL- 3.0.5 CHECK VALVE #43 FLOW TO DRAIN

In Filling Program all flow goes through valve #43. This procedure checks if valve #43 is opening properly. A 1000 ml graduated cylinder is required:

a) Disconnect the female connectors from each other but **do NOT** return them to the male probes at chamber #69 yet! **SEPERATE them so that they do NOT contact each other!** This simulates 'air in chamber #69.

b) Allow 30 seconds. From debug screen 1, ASSURE **FILACT** = 1 (Filling Program active) constant.

c) Referring to the Figure (right), at the far end of the drain tubing, if a 'Quick Connector' is present, an adaptor IS required to allow flow.

d) **IMPORTANT!** Assure Dialysate Flow is ON (Dialysate Flow on/off LED off).

e) **IMPORTANT!** Do NOT reset alarms!

f) Allow 30 seconds

g) ACCURATELY measure drain flow for 30 seconds into a 1000 ml graduated cylinder. Two measurements are recommended especially if the first is low. 250 ml or greater?

Yes See procedure number FIL- 3.0.7 (page 173).

No a) If Dialysate flow is NOT on (Dialysate Flow on/off LED off) repeat FIL- 3.0.5 (page 172), from part d.

b) See procedure number FIL- 3.0.6 (page 172).

FIL- 3.0.6 ISOLATE VALVE #43 / ACTUATOR BOARD

a) **IMPORTANT!** Place BOTH dialyzer connectors into the shunt and close the door.

b) From debug screen 1, ASSURE **FILACT** remains = 1.

c) Allow four minutes to allow valve #43's solenoid to become warm (if energized).

d) Referring to Figure 66 (page 171), and after four minutes, touch valve 43's (black) solenoid. Is it warm (i.e. energized)?

Yes The actuator board is okay. Replace valve #43.

No **NOTE** that VALVE #43 (ONLY) will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

FIL- 3.0.7 CHECK FOR AIR

a) CAREFULLY return the female connectors to their probes on top of chamber #39. **Brown wire on top!**

b) **IMPORTANT!** Place BOTH dialyzer connectors into the shunt!

c) With the shunt door open and referring to the Figure (right), check the external dialysate line filter #73 (if present) for restrictions.

d) Close the shunt door.

e) **IMPORTANT!** ASSURING Dialysate flow is ON (Dialysate Flow on/off LED off), allow one minute.

f) From debug screen 1, watch **FILACT** for one minute. Proceed accordingly:

- **FILACT = 1 (constant):** See procedure number FIL- 3.0.8 (page 173).
- **FILACT = 1 (intermittent):** See procedure number FIL- 7.0.0 (page 176).
- **FILACT = 0 (constant):** Reseating the connectors may have remedied the problem. Do NOT continue.

FIL- 3.0.8 CHECK FILLING PROGRAM

a) Turn the machine off for two minutes then turn it back on.

b) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

c) Allow **eight minutes** for Temperature and Conductivity to stabilize.

d) From debug screen 1, does **FILACT** remain = 1 constant?

Yes See procedure number FIL- 7.0.0 (page 176).

No Do NOT continue!

FIL- 3.2.0 CHECK AIR SENSOR CIRCUIT

a) Referring to the Figure (right), CAREFULLY place one of the resistor plugs, from the four-resistor Temperature set, into distribution board position labeled "AIR-SEN". This simulates 'no air in chamber #69'.

b) **IMPORTANT!** Allow 30 seconds. **FILACT** response is not instantaneous! From debug screen 1, is **FILACT** = 0 constant?

Yes The female X6 connector is bad (see Figure 66, page 171).

No a) ASSURE the resistor plug is placed correctly (at distribution board "AIR-SEN") before continuing! If not, repeat procedure number FIL- 3.2.0 (page 173).

b) See procedure number FIL- 4.0.0 (page 174).

FIL- 4.0.0 TROUBLESHOOTING THE AIR SENSOR CIRCUIT

Leaving the resistor installed at distribution board position "AIR-SEN". Five possibilities: **1)** Bad sensor board [a]; **2)** Bad sensor cable [b]; **3)** Bad function board [c]; **4**) Bad distribution board; **5)** Bad motherboard.

[a] Swap in a known good sensor board. Enter Service Mode → Options → Hardware Options. Set T and C (Test and Calibration) to "Yes". Press the 'CONFIRM' key (the "x" turns blue). From debug screen 1, if **FILACT** = 0 the previous sensor board is bad.

[b] The cable can be checked for continuity. **NOTE** that one (1) **AIR SENSOR** connection will be checked and proceed to page 228, SECTION 17 - CHECKING THE SENSOR BOARD CABLE.

[c] Swap in a known good function board. Place this function board into T and C. From debug screen 1, if **FILACT** = 0 the previous function board is bad.

FIL- 5.0.0 RE-CHECK LOADING PRESSURE/FLOW ERROR

Filling Programs can mask Flow Errors. This procedure assures that a Flow Error is not present when **FILACT** = 0.

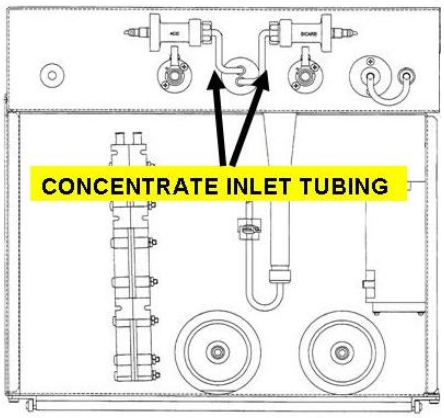
a) Re-check loading pressure. If (and ONLY if) it is NOT peaking to between: 23 and 27 psi (equipped with DiaSafe® filter); 17 and 23 psi (NOT equipped with DiaSafe® filter) proceed to **page 18**, procedure number **F- 2.0.4**.

b) Call debug screen 0 and CAREFULLY watch **Flow Error** for **two minutes** or until if **Flow Error** = 1. Proceed accordingly:

- **Flow Error = 0 (constant):** See procedure number FIL- 5.1.0 (page 174).
- **Flow Error = 1 (constant or intermittent):** Proceed to **page 14**, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM

FIL- 5.1.0 FILLING PROGRAM CHECKS

If a low KUF dialyzer is used with a high UF Rate (UFR) frequent intermittent Filling Programs may occur. In this event, using a larger KUF dialyzer may solve the problem. Proceed through the following steps to locate a possible air leak. **NOTE: If an air leak is located in any step this may be the problem!**



a) ASSURE the dialyzer quick connectors are attached to the dialyzer or shunt door properly.

b) Referring to the Figure (right) and using a flashlight, check through the concentrate inlet tubing for air.

c) Referring to the Figure (below, right), open the shunt door and check external dialysate line filter #73 (if present) for restrictions.

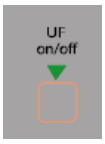
d) Close the shunt door and **IMPORTANT!** allow 30 seconds.

e) From debug screen 1, assure **FILACT** remains = 0.

f) Clear all blood alarms and turn the blood pump on to greater than 200 ml/min.

g) Set UF GOAL to 3000 ml/Hr. Set UF RATE to 700 ml/hr and press the 'CONFIRM' key.

h) Press the UF on/off key (front panel) to turn UF on (UF on/off LED on) until TMP increases to about 140 mmHg then **turn UF off** (UF on/off LED off). TMP should not be greater than 250 mmHg to continue.



i) Using a flashlight, check through the post-dialyzer dialysate tubing (bad quick connector o-ring?).

j) Referring to Figure 315 (page 175), check through chamber #69's input tubing (**towards the rear of the machine**). Is air seen?

Yes See procedure number FIL- 6.0.0 (page 175).

No Watch **FILACT** for three minutes. If (and ONLY if) **FILACT** = 1 (constant or intermittent) see procedure number FIL- 6.0.0 (page 175). If **FILACT** remains = 0 the Troubleshooting Guide is unable to locate an immediate problem!

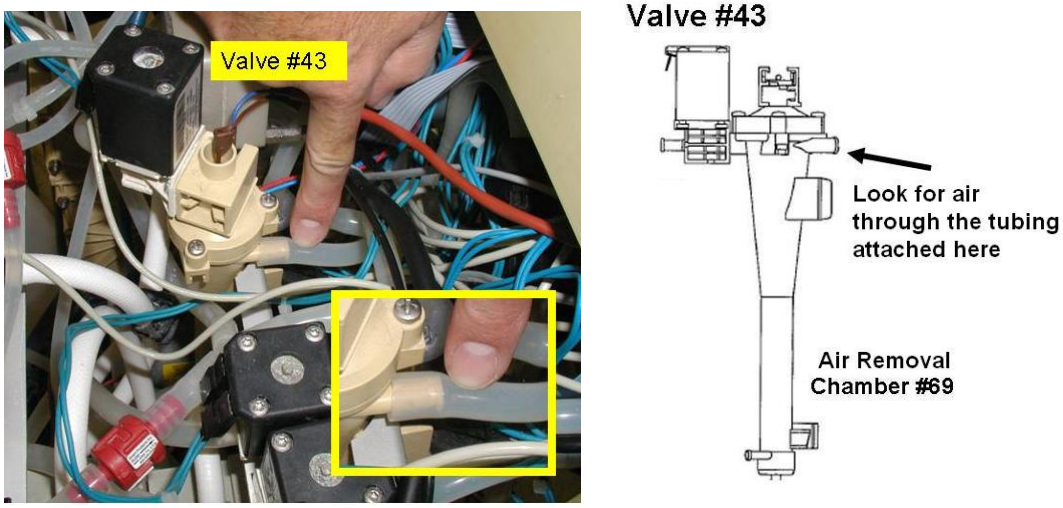
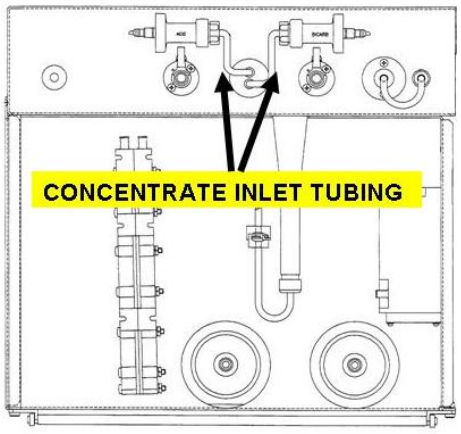


Figure 315 - Chamber #69 Air Check

FIL- 6.0.0 CHECK FOR AIR LEAKS

NOTE this page and procedure number in case you need to return here! Proceed through these checks until a problem is found.



1. Referring to the Figure (right), check for excessive air through the clear concentrate inlet tubing. **If a leak is located this may be the problem!**
2. Referring to Appendix A (page 260), check Deaeration pressure per Preventative Maintenance Procedures. **If deaeration pressure is inadequate this may be the problem!**
3. Perform SECTION 12 - INDUCED POSITIVE PRESSURE TESTS (page 208) to check for external water leaks. **If a leak is located this may be the problem!**
4. Perform SECTION 11 - INDUCED AIR LEAK TESTS (page 202) to check for air leaks.
5. **NOTE** four leak tests will be performed, Spent Side Balancing Chamber Valves #32, #34, #36, #38 through #38 then see SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

FIL- 7.0.0 CHECK FOR LEAKS

NOTE the page and procedure number in case you need to return here! Proceed through these checks until a problem is found.

1. Referring to the Figure (above, right), check for excessive air through the clear concentrate inlet tubing. **If a leak is located this may be the problem!**
2. Referring to Appendix A (page 260), check Deaeration pressure per Preventative Maintenance Procedures. **If deaeration pressure is inadequate this may be the problem!**
3. Perform SECTION 12 - INDUCED POSITIVE PRESSURE TESTS (page 208) to check for external water leaks. **If a leak is located this may be the problem!**
4. Perform SECTION 11 - INDUCED AIR LEAK TESTS (page 202) to check for air leaks. **If a leak is located this may be the problem!**
5. **NOTE** four leak tests will be performed, Spent Side Balancing Chamber Valves #32, #34, #36, #38 then see SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).
6. If the above procedures have been performed correctly AND **FILACT** remains = 1 the air sensor probes (inside air removal chamber #69) may be bad.

SECTION 9 - TMP PROBLEMS

A. Assure the vent tubing (see Figure 6, page 13) is not pinched or clamped.

B. Assure the drain tubing is no more than three feet above the floor and should NEVER be inserted so that its opening is submersed.

C. Referring to the Figure (right), ASSURE the dialyzer connectors are placed correctly in the shunt door.

D. Assure the external flow indicator (#75) is vertical (see Figure right)! **If not, this may cause TMP problems!**

E. **IMPORTANT!** If Automated Tests start (screen reads "Test …") at ANY time allow them to complete! Automated Testing, while troubleshooting, may cause misdiagnosis! IGNORE all test fail messages for now.

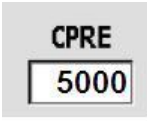
F. Remove the venous 'dummy chamber' from the Level Detector module to prevent "Forced Test".

G. See procedure number TMP- 1.0.0 (page 177).

TMP- 1.0.0 CHECK 'IN BYPASS' FLOW

a) From the Home screen, set Dialysate Flow rate to 500 ml/min (NOT "a500") then press the 'CONFIRM' key. ASSURE Dialysate Flow is on (Dialysate Flow on/off LED off) and the machine is connected to fresh concentrate.

b) Call debug screen 5. After no more than five minutes if (and ONLY if) **CPRE** does not reach greater than 5000 proceed **to page 128**, SECTION 5 – CONDUCTIVITY PROBLEMS



c) **IMPORTANT!** Open the shunt door.

d) Press and release the 'RESET' key then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. If a TMP alarm occurs attempt the RESET sequence up to twice more then continue.

e) Call debug screen 6 and CAREFULLY watch **BC Switch** for one minute. Does it EVER = 897?

Yes See procedure number TMP- 1.0.1 (page 177)

No See procedure number TMP- 1.0.4 (page 178).

TMP- 1.0.1 TROUBLESHOOT FLOW ERROR FROM RINSE

a) Close the shunt door and plug the concentrate connectors into their respective rinse ports.

b) Place the machine into Rinse Program.

c) Is the external flow indicator's (#75) 'bob' rising, **at least ½ way**, and falling?

Yes See procedure number TMP- 1.0.2 (page 177).

No a) Connect to concentrate and return to Dialysis Program (remember to press the 'CONFIRM' key).

b) Proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM.

TMP- 1.0.2 CHECK 'IN BYPASS CIRCUIT'

a) Allow rinse to continue for two full minutes.

b) Press the 'Escape' key then the 'CONFIRM' key twice to return to the "Select Program" screen.

c) Connect to concentrate and return to Dialysis program (remember to press the 'CONFIRM' key).

d) From the Home screen, set Dialysate flow to 800 ml/min and press the 'CONFIRM' key.

e) **IMPORTANT!** With the Bypass LED ON **CONSTANT** is the flow indicator's 'bob' rising, at least ¼ up, and falling?

Yes Proceed to **page 51**, procedure number **F- 14.0.9**.

No Proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM.

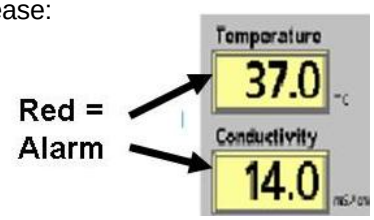
TMP- 1.0.4 CHECK 'OUT OF BYPASS' CIRCUIT

With the shunt door remaining open:

a) From the Home screen, allow **Temperature** and **Conductivity** to increase:

1) **Temperature** to between 35.1 and 38.9° C AND does not vary more than +/- 0.15° C. **The Temperature window MUST NOT be RED!**

2) **Conductivity** MUST be between 13.0 and 14.5 mS AND does not vary greater than +/- 0.2 mS. **If the Conductivity window is red adjust the conductivity alarm limits.**



b) **IMPORTANT!** Do not reset alarms until instructed!

c) **IMPORTANT!** Close the shunt door.

d) ASSURE Dialysate Flow remains at 500 ml/min (NOT "a500").

e) **IMPORTANT!** With the Bypass LED (front panel) OFF constant is the 'bob' inside external flow indicator (#75) is rising up (at least ¼ way) and falling?

Yes See procedure number TMP- 1.0.5 (page 178).

No a) ASSURE Dialysate flow is set to 500 ml/min. If NOT, repeat procedure number TMP- 1.0.4 (page 178).

b) Proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM.

TMP- 1.0.5 CHECK FILLING PROGRAM (FILACT)

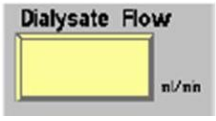
Call debug screen 1. Watch **FILACT** for one minute. Proceed accordingly:

- **FILACT = 1 (constant or intermittent):** Proceed to page 168, SECTION 8 - FILLING PROGRAM PROBLEMS.
- **FILACT = 0 (constant):** See procedure number TMP- 1.0.6 (page 178).

TMP- 1.0.6 CHECK 'OUT OF BYPASS' FLOW STABILITY (500 ml/min)

a) Call debug screen 1. If **NPHT** is less than 600 press and hold the "1" numeric keypad until **NPHT** is greater than 600. **Ignore an "On Line PHT Failed" message if it occurs for now**. Allow one minute then continue with part b.

b) From the Home screen, ASSURE Dialysate Flow rate is set to 500 ml/min (NOT "a500"). **IMPORTANT!** If flow rate is or was changed allow three minutes for stabilization. **If Flow is manually changed press the "CONFIRM' key!**



= 300, 500 or 800 ml/min

c) **IMPORTANT!** Unless instructed, do NOT reset alarms!

d) Call debug screen 6 and CAREFULLY watch **BC Switch** (**B**alancing **C**hamber **S**witching **T**ime) for one minute. Is it remaining between 324 and 396 (3.24 and 3.96 seconds)?

Yes The 'Out of Bypass' circuit is okay. See procedure number TMP- 1.0.7 (page 179).

No a) Call the Home screen and check the selected flow rate. It may have defaulted to a different rate other than 500 ml/min (idle flow option). If (and ONLY if) flow rate has changed repeat procedure number TMP- 1.0.6 (page 178).

b) Proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM.

TMP- 1.0.7 CHECK 'IN BYPASS' FLOW STABILITY (500 ml/min)

a) Open the shunt door, to cause bypass. Allow 15 seconds.

b) CAREFULLY watch **BC Switch** for 30 seconds. Is it remaining between 324 and 396?

Yes The 'In Bypass' circuit is okay. See procedure number TMP- 1.0.8 (page 179).

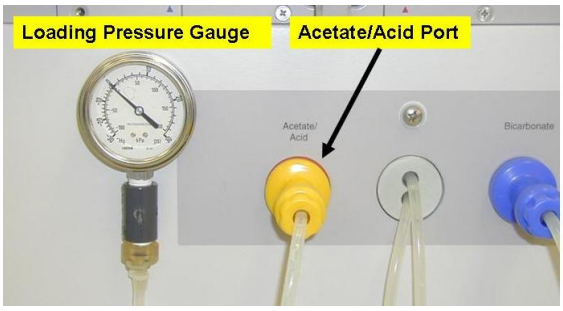
No a) Call the Home screen and check the selected flow rate. It may have defaulted to a different rate other than 500 ml/min (idle flow option). If (and ONLY if) flow rate has changed repeat procedure number TMP- 1.0.6 (page 178).

b) Proceed to **page 14,** SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM**.**

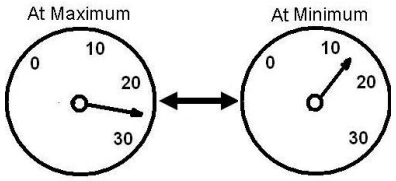
TMP- 1.0.8 CHECK LOADING PRESSURE

a) Close the shunt door.

b) Assuring the loading pressure gauge (with yellow connector) reads 0 psi before inserting, **SLAM** it into the red acetate/Acid rinse port (see Figure right).



c) Per Table D (page 179), loading pressure MUST be **fluctuating** to its maximum **AND** NEVER dropping below the minimum. CAREFULLY watch BOTH levels for two minutes. Is loading pressure okay?



Yes See procedure number TMP- 1.0.9 (page 179).

No Proceed to **page 18**, procedure number **F- 2.0.4**.

Table D – Loading Pressure

DiaSafe® Filter?	Maximum	No lower than:
Yes	23 – 27 psi	15 psi
No	17 – 23 psi	11 psi

TMP- 1.0.9 CHECK FILLING PROGRAM FUNCTION (FILACT)

a) Referring to the Figure (right), UNPLUG the air sensor's connector from distribution board position labeled "AIR-SEN" (**4th connector cap from the left**).

b) With "AIR-SEN" empty**, IMPORTANT!** ALLOW **30 seconds** BEFORE continuing! **FILACT** response in not instantaneous!

c) From debug screen 1, does **FILACT** = 1?

Yes a) **IMPORTANT!** CAREFULLY return the air sensor's connector to distribution board position labeled "AIR-SEN". Allow 30 seconds then ASSURE **FILACT** returns to = 0.

b) See procedure number TMP- 1.0.10 (page 180).

No a) Not likely! ASSURE that distribution board position "AIR-SEN" is EMPTY before continuing! If not, repeat procedure number TMP- 1.0.9 (page 179).

b) After 30 seconds, If (and ONLY if) **FILACT** still = 0, Filling Program is malfunctioning. Proceed to **page 17**, procedure number **F- 1.0.10**.

TMP- 1.0.10 DETERMINE TMP PROBLEM

a) Call the Home screen. Assure Dialysate flow is set to 500 ml/min.

b) Referring to Figure 67 (page 180), the TMP bar graph is populated with three horizontal **bars**; yellow upper and lower alarm Limits (at 520 and 0) and an 'actual' TMP **bar** which is either red (with a TMP alarm) or green (no TMP alarm).

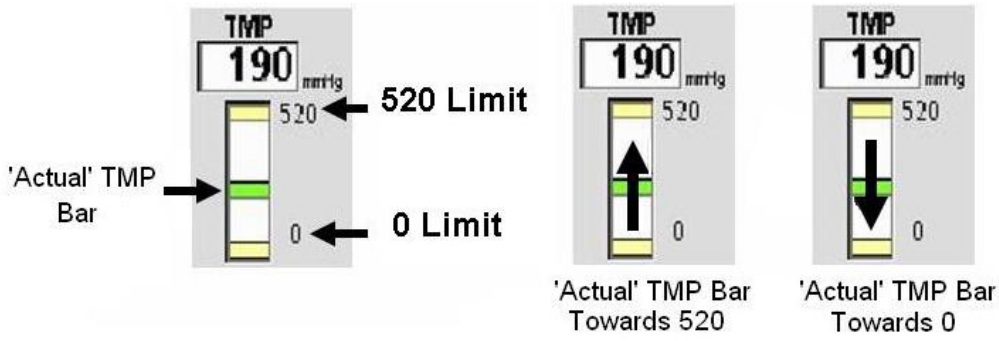


Figure 67 – TMP Bar Graph

c) Press and release the 'RESET' key then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. **Ignore temporary Flow Errors during reset!** If a TMP alarm occurs attempt the RESET sequence up to twice more then continue.

d) Watch the (green or red) 'actual' TMP bar. TMP is STABLE if (and ONLY if) it REMAINS between the 0 and 520 limits AND varies less than +/- 40 mmHg in two minutes. Proceed accordingly (three scenarios):

1. **TMP is UNSTABLE if the 'actual' TMP bar rises (↑), greater than +40, towards the 520 Limit OR exceeds the 520 Limit causing a "TMP Is High" alarm:** See procedure number TMP- 1.0.15 (page 181).
2. **TMP is UNSTABLE and the 'actual' TMP bar falls (↓), greater than -40, towards the lower 0 Limit OR falls below the 0 Limit causing a "TMP Is LOW" alarm:** See procedure number TMP- 1.0.15 (page 181).
3. **TMP is STABLE AND the 'actual' TMP bar is REMAINING between the 520 and 0 Limits:** Is the 'actual' TMP bar green?

   Yes See procedure number TMP- 1.3.0 (page 182).

   No See procedure number TMP- 1.0.11 (page 181).

TMP- 1.0.11 TROUBLESHOOT RED TMP BAR

ASSURE the 'actual' TMP bar is stable between the 0 and 520 Limit. Proceed accordingly:

- **TMP bar REMAINS red:** Three possibilities: 1) Bad actuator board; 2) Bad function board; 3) Bad motherboard.
- **TMP bar is green:** See procedure number TMP- 1.3.0 (page 182).

TMP- 1.0.15 CHECK DIALYSATE PRESSURE TRANSDUCER #9

a) **IMPORTANT!** Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks).

b) Remove the red dialyzer quick connector from the shunt and hang it over the dialyzer holder.

c) **IMPORTANT!** Close the shunt door. Ignore "Emptying" related messages.

d) Call debug screen 4. Is **PDIA** (left column) between 4.0 and 6.0 volts?

Yes a) **IMPORTANT!** Return BOTH dialyzer lines to the shunt and close the door!

b) **IMPORTANT!** Turn Dialysate flow ON (Dialysate Flow on/off LED off).

c) See procedure number TMP- 1.0.16 (page 181).

No See procedure number TMP- 2.1.0 (page 184).

TMP- 1.0.16 CHECK FOR LEAKS

a) Referring to Figure 68 (page 181), remove the UF Sample Connector from its port. If (and ONLY if) water is leaking from the Sample Connector rebuild the Ultrafiltration Pump (#22) **AND** replace check valve #63 per Preventative Maintenance procedures. **If a leak is located this is probably the problem!**

b) **THOROUGHLY** (use a flashlight) check inside the hydraulic drawer, the DiaSafe® filter (if equipped), and the entire length of external dialysate lines all the way back to where they connect at the rear of the machine (see Figure 68) for an external water leak. **If a leak is located this is probably the problem!**

c) See procedure number TMP- 1.0.17 (page 182).

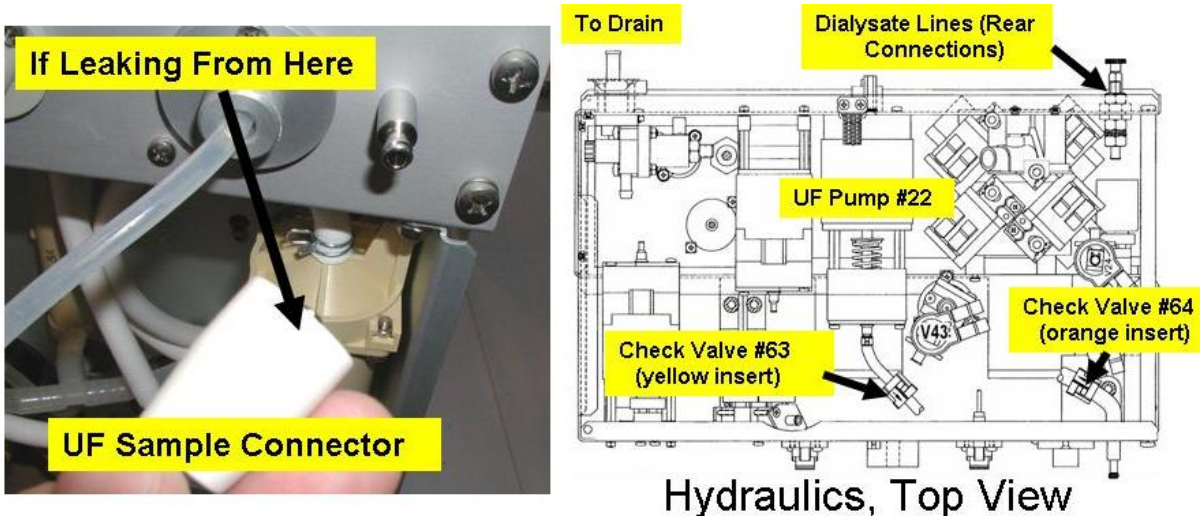


Figure 68 – UF Sample / Check Valves

TMP- 1.0.17 CHECK FILLING PROGRAM (FILACT)

Call debug screen 1. Watch **FILACT** for one minute. Proceed accordingly:

- **FILACT = 1 (constant or intermittent):** Proceed to page 168, SECTION 8 - FILLING PROGRAM PROBLEMS.
- **FILACT = 0 (constant):** See procedure number TMP- 1.3.0 (page 182).

TMP- 1.3.0 CHECK VENOUS PRESSURE STABILITY

a) Assure the P_{ven} port (at the Level Detector module) is EMPTY.

b) From debug screen 1, if (and ONLY if) **VEN** does NOT = 0 +/- 5 calibrate VENOUS PRESSURE per procedure.

c) Referring to the Figure (right), attach a piece of tubing, with a syringe attached, to the P_{ven} port.

d) Push on the syringe plunger until **VEN** is approximately +300 mmHg then **clamp the syringe**.

e) A decrease of greater than 3 mmHg in 30 seconds may indicate a leak inside the Level Detector module.

f) **IMPORTANT!** Do NOT detach the tubing so that **VEN** remains about 300 mmHg for subsequent procedures.

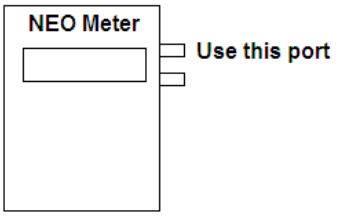
g) See procedure number TMP- 1.4.0 (page 182).

TMP- 1.4.0 PRESSURE TEST

a) **IMPORTANT!** Turn Dialysate flow is OFF (Dialysate Flow on/off LED blinks).

b) Referring to the Figure (below, right), attach the four way test assembly to the dialyzer connectors. Hang the assembly over the dialyzer holder.

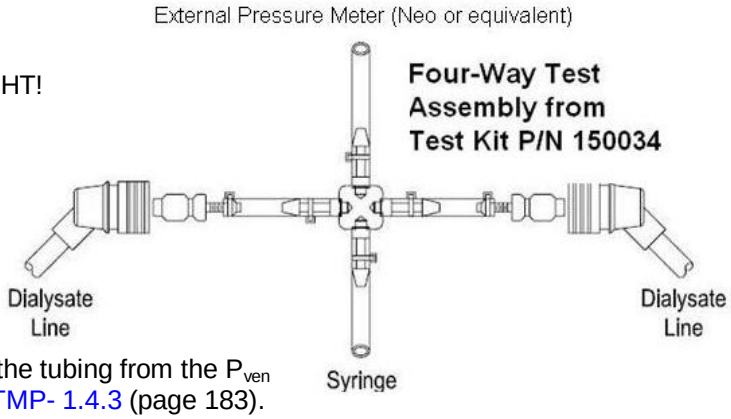
c) If using a NEO-2 meter, attach to the TOP pressure port (see Figure right)!



d) **IMPORTANT!** Close the shunt door!

e) ASSURE all assembly connections are TIGHT!

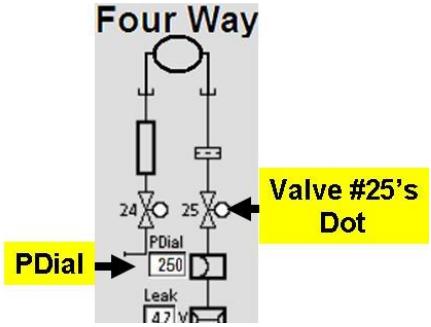
f) Pull on the syringe plunger. Are you able to create approximately -250 mmHg **AND** HOLD it (+/- 20 mmHg per minute) on the external meter?



Yes See procedure number TMP- 1.4.2 (page 183).

No Negative pressure leak! Remove the tubing from the P_{ven} port then see procedure number TMP- 1.4.3 (page 183).

TMP- 1.4.2 CHECK PDIAL (DIALYSATE PRESSURE)



a) Clamp the four way's syringe tubing to hold pressure!

b) Call debug screen 0. If valve #25's dot IS blue (see Figure right) then valve #25 is open. Continue to part c. If the dot is NOT blue increase **VEN** (screen 1). If unable to make the dot blue remove the tubing from the P_{ven} port then see procedure number TMP- 6.0.0 (page 187).

c) Monitor the **PDial** data window (see Figure right). Two scenarios:

1) **PDial AGREES with the external meter within +/- 25 mmHg:** See procedure number TMP- 1.4.5 (page 184).

2) **PDial does NOT agree with the external meter within +/- 25 mmHg:** See procedure number TMP- 6.0.0 (page 187).

TMP- 1.4.3 ISOLATE SECONDARY CIRCUIT

a) **Be CAREFUL HERE!** Referring to Figure 69 (page 183), DOUBLE clamp the tubing at valve #43's output nozzle (towards the **FRONT** of the machine). Figure 73 B (page 197) illustrates the hydraulic circuit isolation area.

b) Can you create approximately -250 mmHg AND hold it (+/- 20 mmHg per minute) now?

Yes See procedure number TMP- 1.4.7 (page 184).

No a) Open the shunt door (valve #24 and #25 close). Figure 73 C (page 197) illustrates the isolation area.

b) Pull on the syringe then clamp the syringe tubing. Can you create approximately -250 mmHg **AND** hold it (+/-20 mmHg per minute) on the external meter now?

Yes There is a large negative pressure leak in the secondary side hydraulics. Remove the clamps from valve #43 then see procedure number TMP- 8.1.0 (page 189).

No a) Remove the clamps from valve #43!

b) Check the four way assembly connections for a leak. If SURE that the assembly is NOT leaking see procedure number TMP- 8.1.0 (page 189).

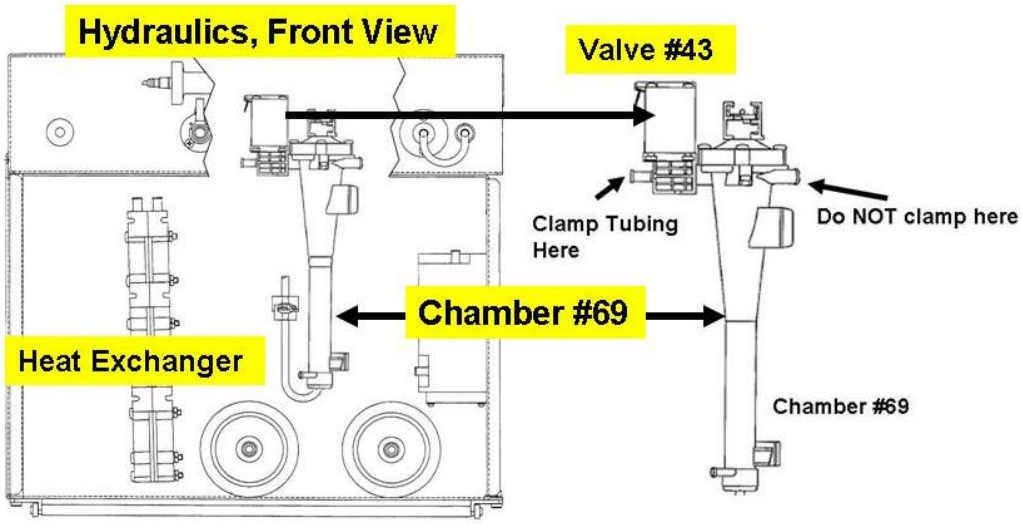


Figure 69 – Clamping Valve #43

TMP- 1.4.5 CHECK PDIAL ZERO / PERFORM POSITIVE TEST

a) Using the syringe set pressure on the external meter to 0 mmHg. If (and ONLY if) **PDial** does NOT = 0 +/- 25 see procedure number TMP- 6.0.0 (page 187).

b) Push on the syringe plunger. Are you able to create approximately +250 mmHg **AND** HOLD it (+/- 20 mmHg per minute) on the external meter?

Yes a) Remove the tubing from the P_{ven} port at the Level Detector module.

b) See procedure number TMP- 1.4.6 (page 184).

No There is a positive pressure leak in the secondary side hydraulics! Remove the tubing and syringe from the P_{ven} port then see procedure number TMP- 8.1.0 (page 189).

TMP- 1.4.6 ANALYZE TMP

a) Remove the four way assembly and close the shunt door.

b) Turn Dialysate flow ON (Dialysate Flow on/off LED off).

c) From the Home screen, allow Temperature and Conductivity to become normal.

d) From debug screen 1 and ASSURE **FILACT** = 0.

e) Press and release the 'RESET' key then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. **Ignore temporary Flow Errors during reset!** If the 'actual' TMP bar turns red attempt the RESET sequence up to twice more then continue.

f) Referring to Figure 67 (page 180), watch the (red or green) 'actual' TMP bar for two minutes. TMP is STABLE if it remains between the 520 and 0 Limits AND varies less than +/- 60 mmHg in three minutes. Proceed accordingly (two scenarios):

1) **TMP is STABLE:** See procedure number TMP- 5.0.0 (page 186).

2) **TMP is UNSTABLE:** See procedure number TMP- 8.0.0 (page 188).

TMP- 1.4.7 ISOLATE VALVE #43 / ACTUATOR BOARD

Two possibilities: 1) Bad actuator board; 2) Bad valve #43. This procedure isolates between the two:

a) Remove the clamps from valve #43's. If valve #43 is leaking the external meter's pressure becomes UNSTABLE again.

b) **IMPORTANT!** From debug screen 1, ASSURE **FILACT** = 0 (constant).

c) Referring to Figure 69 (page 183), touch valve #43's (black) solenoid. Is it warm?

Yes Replace the actuator board (see Figure 4A, page 8).

No Replace valve #43 (leaking).

TMP- 2.1.0 CHECK DIALYSATE PRESSURE CONNECTION

a) Referring to Figure 70 (page 185), ASSURE the dialysate pressure transducer #9 is plugged into distribution board position labeled x9, "PDIAL". **If not plugged in this is the problem!**

b) Referring to Figure 70, using a flashlight, CAREFULLY check the (blue) dialysate pressure transducer's (#9) body for signs of (rust colored) external leakage. **Replace the transducer if leakage is located as this may be the problem!**

c) See procedure number TMP- 2.2.0 (page 184).

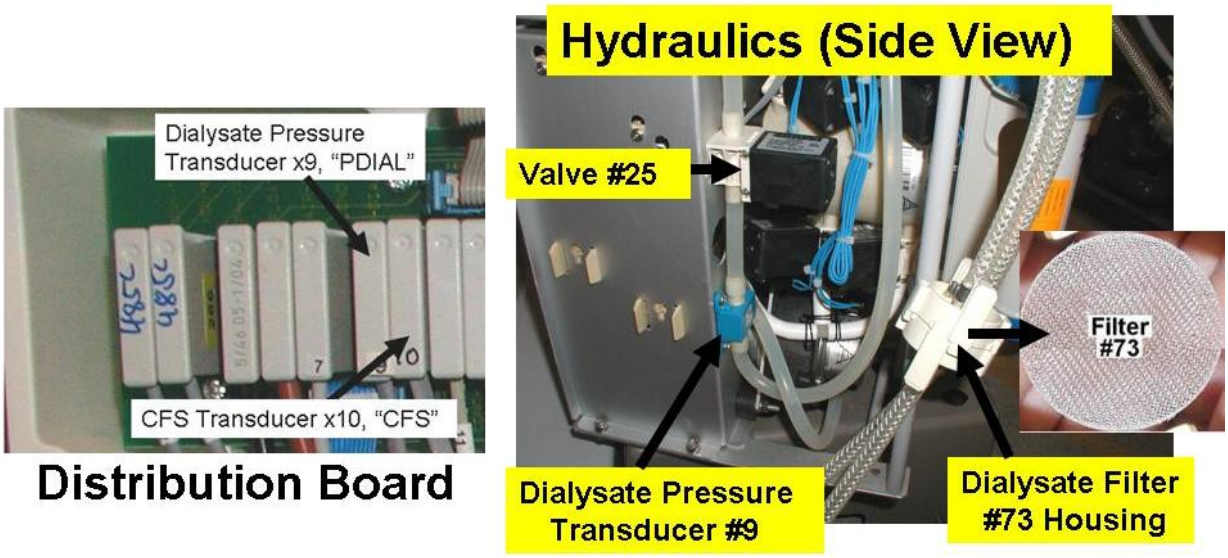


Figure 70 – Distribution Board / Dialysate Pressure Transducer #9

TMP- 2.2.0 CHECK ACFS

a) Remove the red dialyzer quick connector from the shunt and drape it over the dialyzer holder.

b) Assure Dialysate flow is OFF (Dialysate Flow on/off LED blinking).

c) Open the shunt door.

d) Call debug screen 10. Is **ACFS** (lower right corner) between 3.5 and 6.0 volts?

Yes See procedure number TMP- 2.3.0 (page 185)

No See procedure number TMP- 2.4.0 (page 185)

TMP- 2.3.0 ISOLATE DIALYSATE PRESSURE TRANSDUCER

a) Referring to Figure 70 (page 185), CAREFULLY place the CFS transducer's distribution board connector into distribution board position x9, "PDIAL" (6th connector from the left).

b) Call debug screen 4, is **PDIA** = between 3.5 and 6.0?

Yes The dialysate pressure transducer #9 is bad (see Figure 70, page 185). Replace it!

No See procedure number TMP- 3.0.0 (page 186).

TMP- 2.4.0 CHECK PDIA

Call debug screen 4. Proceed accordingly based on **PDIA**:

- **PDIA = less than 4:** See procedure number TMP- 2.5.0 (page 185).
- **PDIA = greater than 6:** See procedure number TMP- 2.6.0 (page 186).

TMP- 2.5.0 ISOLATE PRESSURE TRANSDUCER #9 / POSSIBLE SHORT

a) Referring to Figure 70 (page 185), unplug the Dialysate Pressure Transducer from distribution board position x9, labeled "P-DIAL".

b) **IMPORTANT!** To avoid time consuming error, using the screen's clock (upper right), allow up to five minutes (**PDIA** response is NOT instantaneous). Does **PDIA** increase to 9 or greater?

Yes Dialysate pressure transducer #9 is bad (see Figure 70, page 185).

No See procedure number TMP- 3.0.0 (page 186).

TMP- 2.6.0 ISOLATE PRESSURE TRANSDUCER #9 / POSSIBLE OPEN

a) Referring to Figure 70 (page 185), plug one of the resistor plugs, from the four-resistor Temperature set, into Dialysate Pressure Transducer's distribution board position x9, labeled "P-DIAL".

b) From screen 4, does **PDIA** = less than 1?

Yes The dialysate pressure transducer #9 is bad (see Figure 70, page 185).

No See procedure number TMP- 3.0.0 (page 186

TMP- 3.0.0 ISOLATE THE TEST BOARD

NOTE: With some machines the Actuator and the Test board may be combined (see Figure 4A, page 8). In this event ONLY proceed to TMP- 3.0.1 (page 186).

a) Turn the **machine off** and swap in a known good test board (see Figure 4A, page 8).

b) Return to Dialysis program and debug screen 4. With the red dialyzer quick connector out of the shunt, Dialysate flow off, and the shunt door open, is **PDIA** between 4.0 and 6.0 volts?

Yes Problem solved! The previous test board is bad.

No The previous test board is okay. See procedure number TMP- 3.0.1 (page 186).

TMP- 3.0.1 ISOLATE THE ACTUATOR BOARD

a) Turn the **machine off** and swap in a known good actuator board (see Figure 4A, page 8).

b) Return to Dialysis program and debug screen 4. With the red dialyzer quick connector out of the shunt, Dialysate flow off, and the shunt door open, is **PDIA** between 4.0 and 6.0 volts?

Yes Problem solved! The previous actuator board is bad.

No The previous actuator board is okay. See procedure number TMP- 3.0.2 (page 186).

TMP- 3.0.2 TROUBLESHOOT TMP CIRCUIT

Five possibilities (refer to Figure 4A, page 8): 1) Bad sensor board [a]; 2) Bad sensor cable[b]; 3) Bad function board [c]; 4) Bad distribution board; 5) Bad motherboard.

[a] Swap in a known good sensor board. Enter Service Mode → Options → Hardware Options. Set T and C (Test and Calibration) to "Yes". Press the 'CONFIRM' key (the "x" turns blue). With the red dialyzer quick connector out of the shunt, Dialysate flow off, and the door open, if **PDIA** is between 4.0 and 6.0 volts the previous sensor board is bad.

[b] The cable can be checked for continuity. **NOTE** that four (4) **DIALYSATE TRANSDUCER** connections will be checked and proceed to page 228, SECTION 17 - CHECKING THE SENSOR BOARD CABLE.

[c] Swap in a known good function board. Place the new function board into T and C. With the red dialyzer quick connector out of the shunt, Dialysate flow off, and the door open, if **PDIA** is between 4.0 and 6.0 volts the previous function board is bad.

TMP- 5.0.0 PERFORM PRESSURE TESTS

a) Remove the tubing from the P_{ven} port at the level Detector Module.

b) Turn Dialysate flow ON (Dialysate Flow on/off LED off) and allow Conductivity and Temperature to stabilize.

c) RESET all blood alarms and select the screen's Test & Options button. If the 'Pressure Test' button is:

- **Gray (ghosted):** Select the 'Both Tests' button then press the 'CONFIRM' key
- **Blue (active):** Select the 'Pressure Test' button then press the 'CONFIRM' key.

d) Allow the Pressure Tests (Neg Flow On, Pos Flow Off) to complete: Two scenarios:

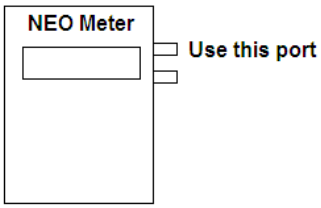
1) Pressure Tests FAIL: Proceed to **page 194**, procedure number **PHT- 2.2.0**.

2) Pressure Tests PASS: Repeat the Pressure Tests. Do they pass again?

Yes See procedure number TMP- 7.0.0 (page 188).

No Proceed to **page 194**, procedure number **PHT- 2.2.0**.

TMP- 6.0.0 CALIBRATE DIALYSATE PRESSURE



This is NOT a routine calibration. Follow the instructions exactly to avoid error!

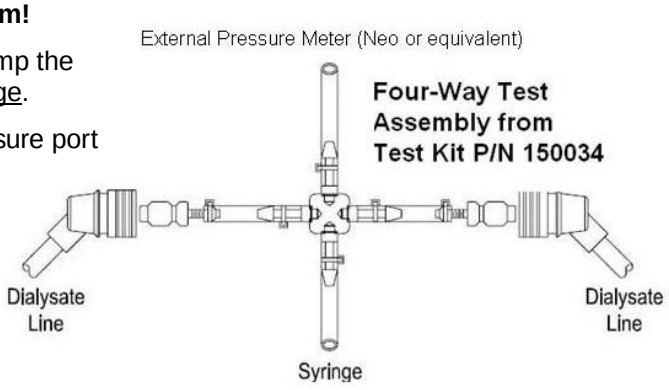
a) Referring to **Figure 70** (page 185), using a flashlight, CAREFULLY check the (blue) dialysate pressure transducer (#9) for signs of external (rust colored) fluid leakage. **Replace the transducer if leakage is located as this may be the problem!**

b) At the four way assembly (see Figure right) clamp the tubing attached to the external meter and syringe.

c) If using a NEO-2 meter connect to the top pressure port (see Figure above, right).

d) Place the machine into Service Mode → Calibrate Sensors → Dialysate Pressure.

e) **Assure the shunt door is closed** and there is 'air free' flow through the external flow indicator (#75).



f) Press the 'CONFIRM' key. The screen changes.

g) **IMPORTANT!** Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks).

h) **IMPORTANT!** Remove the clamps from the external meter and syringe tubing!

i) Using the syringe, adjust pressure until the external meter reads 0 +/- 2 mmHg. The screen's [Dial Pressure Reference] data box reads approximately 100 if the procedure was performed correctly and the dialysate pressure circuit is okay.

j) Press the "CONFIRM' key. Does the message "Operator Error" occur?

Yes See procedure number TMP- 6.3.0 (page 188).

No The screen changed. See procedure number TMP- 6.1.0 (page 187).

TMP- 6.1.0 CONTINUE DIALYSATE PRESSURE CALIBRATION

a) Pull on the syringe to create negative (-) 250 +/- 2 mmHg on the external meter. **IMPORTANT!** If (and ONLY if) -250 cannot be achieved OR pressure does not HOLD (+/- 20 mmHg per minute) see procedure number TMP- 1.4.3 (page 183).

b) Clamp the syringe tubing to HOLD pressure. **IMPORTANT!** If (and ONLY if) pressure does not HOLD) +/- 20 mmHg per minute) see procedure number TMP- 1.4.3 (page 183).

c) The screen's [Dial Pressure Reference] data box should read approximately 140.

d) Press the "CONFIRM' key. Does the message "Operator Error" occur?

Yes See procedure number TMP- 6.3.0 (page 188).

No Press the 'CONFIRM' key. The calibration is saved. See procedure number TMP- 1.4.6 (page 184).

TMP- 6.3.0 TROUBLESHOOT DIALYSATE PRESSURE

a) Turn the machine off and then back on.

b) CAREFULLY repeat TMP- 6.0.0 (page 187). If "Operator Error" reoccurs seven possibilities: **1)** Bad dialysate pressure transducer (#9); **2)** Bad sensor board (see Figure **70**, page 185); **3)** Bad function board; **4)** Bad sensor cable; **5)** Bad test board; **6**) Bad actuator board; **7)** Bad distribution board.

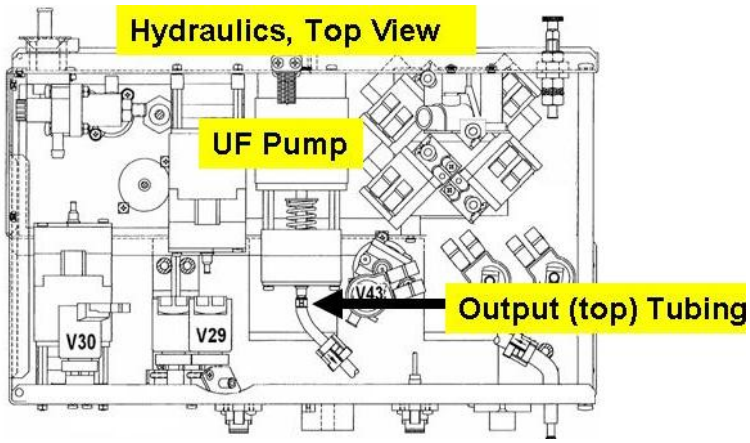
TMP- 7.0.0 UF INTEGRITY CHECK

This procedure checks that the UF pump internal springs are functioning properly

a) Referring to the Figure (right), remove the OUTPUT tubing from the UF pump.

b) Attach a 24 inch piece of tubing to its empty nozzle and direct it away from the machine. During subsequent tests the UF pump will output fluid.

c) From the 'Test & Options' screen perform the Pressure Tests. Do both (Negative and Positive) Pressure tests pass?



Yes Reinstall the tubing (three checks). **1)** UF PUMP per Preventative Maintenance Procedures; **2)** If the TMP problem reoccurs replace the DiaSafe® Filter (if equipped) per procedure. **3)** Assuming that all above procedures were performed correctly, if the problem reoccurs the Troubleshooting Guide is unable to determine an immediate problem. The dialysate pressure transducer (#9) may be bad intermittent (see Figure 70, page 185).

No CAREFULLY rebuild the UF Pump per Preventative Maintenance Procedures then repeat the automated Alarms/Pressure tests and UF INTEGRITY TEST.

TMP- 8.0.0 CHECK AIR REMOVAL SYSTEM

a) Return the dialyzer lines to the shunt and close the door.

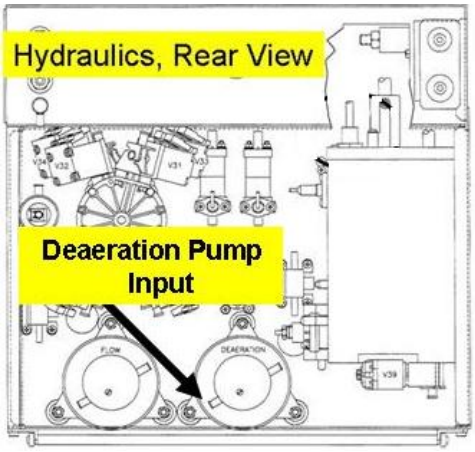
b) Referring to the Figure (right), tee a gauge to the input of the deaeration pump.

c) **IMPORTANT!** Turn Dialysate flow ON (Dialysate Flow on/off LED off).

d) Referring to Appendix A (page 260), is Deaeration pressure okay?

Yes See procedure number TMP- 8.1.0 (page 189).

No See procedure number TMP- 8.2.0 (page 189).



TMP- 8.1.0 TROUBLESHOOT TMP

NOTE this procedure and page number in case you need to return here. Proceed until a problem is found:

a) Perform SECTION 12 - INDUCED POSITIVE PRESSURE TESTS (page 208). If no external leaks are located continue to part b. **If a leak is located this is the problem!**

b) Perform SECTION 11 - INDUCED AIR LEAK TESTS (page 202). If no air leaks are located continue to part c. **If a leak is located this is the problem!**

c) **NOTE** nine leak tests will be performed: **1)** IOS; **2)** Balancing Chamber Valves #31 through #38. See SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

d) Assuming all procedures have been performed correctly the Troubleshooting Guide is unable to determine an immediate problem. If the TMP problem continues replace the DiaSafe® filter (if present) per procedure. If the TMP problem continues the dialysate pressure transducer (#9) may be bad intermittent (see Figure 70, page 185).

TMP- 8.2.0 CALIBRATE DEAERATION PRESSURE

Calibrate DEAERATION AND LOADING PRESSURE per procedure. Is the calibration successful?

Yes Return to Dialysis program (remember to press the 'CONFIRM' key). If the TMP problem continues return to procedure number TMP- 1.0.6 (page 178).

No Proceed to page 211, SECTION 13 - DEAERATION PROBLEMS.

SECTION 10 - PRESSURE TESTS FAILING

A **"On Line PHT Failed":** On Line PHT (Pressure Holding Test), if activated, is performed automatically every 12 minutes (720 seconds). If the "***On Line PHT Failed"*** message occurs more than once during a treatment see procedure number PHT- 1.0.0 (page 190).

B **Pressure Test Failures:** Referring to Figure 71 (page 190), the Alarms and Pressure Tests consist of three parts: ***1) Alarms Tests***; ***2) Negative Pressure Test*** ("Neg Flow On"); ***3) Positive Pressure Test*** ("Pos Flow Off"). If a Pressure Test fails a red 'x' appears in the Error column and one or more of the following messages are presented: "Fail Get Neg TMP", "Fail Neg Stabilize", "Fail Neg Flow On", "Fail Get Pos TMP", "Fail Pos Stabilize", "and Fail Pos Flow Off". See procedure number PHT- 1.0.0 (page 190).

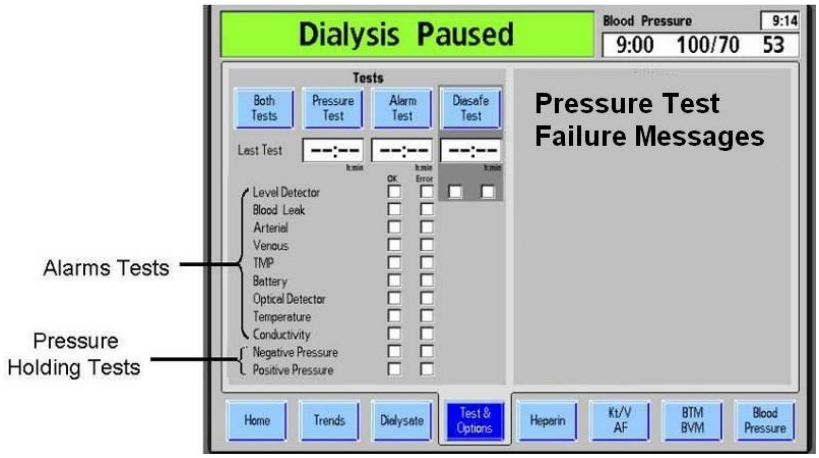


Figure 71 – Test & Options Screen

PHT- 1.0.0 CHECK 'IN BYPASS' FLOW

a) ASSURE the machine has been running, in Dialysis Program, with Dialysate flow on (Dialysate Flow on/off LED off) and connected to fresh concentrate for at least five minutes.

b) **IMPORTANT!** If the screen reads "Test …" allow the test to complete before continuing! **DO NOT restart tests until instructed!**

c) From the Home screen, set Dialysate Flow to 500 ml/min then press the 'CONFIRM' key

d) Call debug screen 5. If (and ONLY if) **CPRE** is not greater than 5000 proceed **to page 128**, SECTION 5 – CONDUCTIVITY PROBLEMS.

e) **IMPORTANT!** Open the shunt door.

f) Call debug screen 6 and CAREFULLY watch **BC Switch** for one minute. Does it EVER = 897?

Yes Proceed to **page 177**, procedure number **TMP- 1.0.1**.

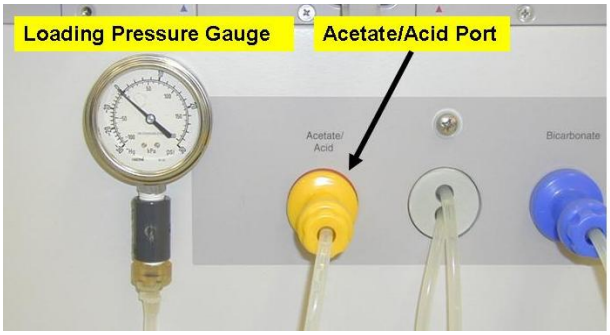
No From the Home screen, watch both **Temperature** and **Conductivity** for one minute: Three checks:

1) If (and ONLY if) Temperature is **NOT** between 35.1 and 38.9° C AND remaining stable (+/- 0.15° C) proceed to **page 92**, SECTION 4 – TEMPERATURE PROBLEMS.

2) If (and ONLY if) Conductivity is **NOT** between 13.0 and 14.5 AND remaining stable (+/- 0.2 mS) proceed to **page 128**, SECTION 5 – CONDUCTIVITY PROBLEMS.

3) If (and ONLY if) **Temperature** and **Conductivity** are okay see procedure number PHT- 1.0.1 (page 191).

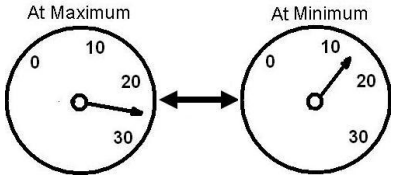
PHT- 1.0.1 CHECK LOADING PRESSURE



a) **IMPORTANT!** Close the shunt door!

b) Assuring the loading pressure gauge (with yellow connector) reads 0 psi before inserting, **SLAM** it into the red acetate/Acid rinse port (see Figure right).

c) Per Table J (page 191), loading pressure MUST fluctuate between its maximum and to a minimum of NO LOWER than that specified. **CAREFULLY** watch BOTH levels for two minutes. Is loading pressure okay?



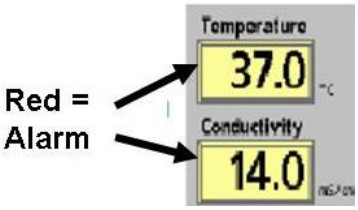
Yes See procedure number PHT- 1.0.2 (page 191).

No Proceed to **page 18**, procedure number **F- 2.0.4**.

Table J - Loading Pressure Levels

DiaSafe® Filter?	Maximum	No lower than:
Yes	23 – 27 psi	15 psi
No	17 – 23 psi	11 psi

PHT- 1.0.2 CHECK 'OUT OF BYPASS' FLOW

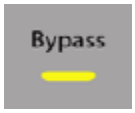


a) From the Home screen, assure the **Temperature** and **Conductivity** windows are NOT RED (see Figure right). If necessary adjust the Conductivity alarm limits.

b) ASSURE Dialysate flow is set 500 ml/min (NOT "a500").

c) **IMPORTANT!** Do not reset alarms unless instructed!

d) **IMPORTANT!** ASSURING the Bypass LED (front panel) is **OFF** is the external flow indicator's 'bob' is rising (at least ¼ way up) and falling?



Yes See procedure number PHT- 1.0.3 (page 191).

No a) If (and ONLY if) Dialysate flow is NOT set to 500 ml/min repeat PHT- 1.0.2 (page 191).

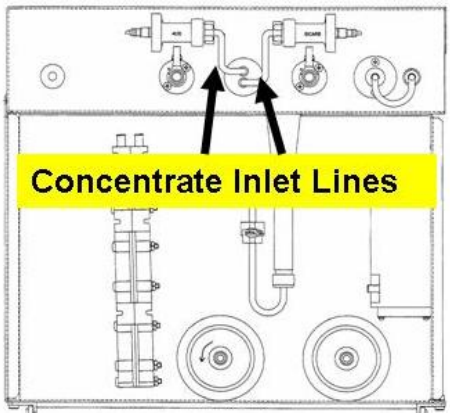
b) Proceed to **page 14**, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM.

PHT- 1.0.3 INITIAL PRESSURE HOLDING TESTS (PHT) CHECKS

a) ASSURE the vent tubing (see Figure 6, page 13) is not pinched or clamped.

b) ASSURE the drain tubing is no more than three feet above the floor and should NEVER be inserted so that its opening is submersed.

c) CAREFULLY check at the DiaSafe® filter (if equipped) and its 'Test' valve for an external water leak. **If (and ONLY if) the DiaSafe® filter is leaking replace it. If (and ONLY if) the 'Test' valve is leaking see procedure number PHT- 10.0.0 (page 200).**

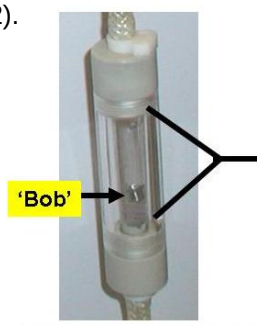


d) Referring to the Figure (right), check through the clear concentrate input tubing for large air bubbles. **If air is seen this may be the problem!**

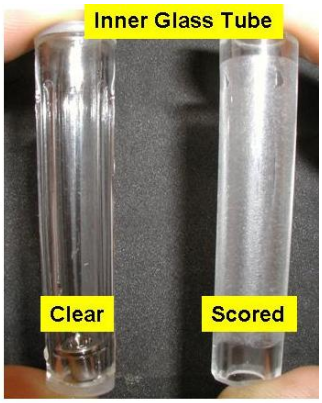
e) **THOROUGHLY** (use a flashlight) check for external water leaks, inside the hydraulic drawer, and the entire length of the external dialysate lines all the way to where they connect at the rear of the machine. **If a leak is located this is probably the problem!**

f) Referring to the Figure (below right), check the external flow indicator for scoring (the inner tube appears cloudy) that may restrict flow and cause pressure failures. Normally the tube is very clear. **If (and ONLY if) scoring is located repair or replace the flow indicator as this may be the problem.**

g) See procedure number PHT- 1.0.4 (page 192).



External Flow Indicator



PHT- 1.0.4 CHECK STATIC UF OUTPUT

a) Referring to Figure 72 (page 192), remove the Fluid Sample Connector from the Fluid Sample port. Two checks for external water leaks:

1. If (and ONLY if) leaking from the Fluid Sample Connector rebuild the UF Pump **AND** replace check valve #63 (yellow insert). **A leak from the Fluid Sample Connector may be the problem!**

2. If (and ONLY if) leaking from the **male** Fluid Sample port, check valve #64 (orange insert) is bad**. A leak from the Fluid Sample port may be the problem!** If (and ONLY if) no leaks from the Connector or port see part b.

b) See procedure number PHT- 1.0.5 (page 193).

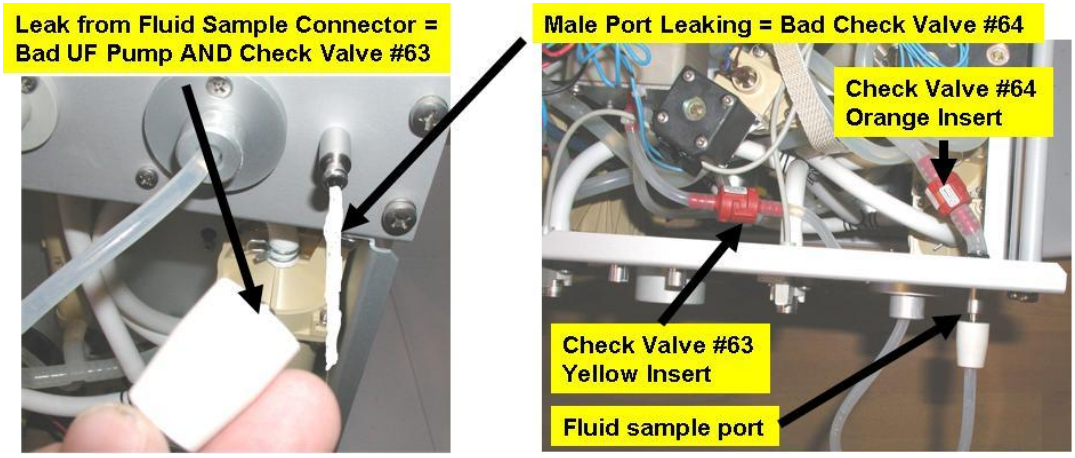

Leak from Fluid Sample Connector = Bad UF Pump AND Check Valve #63
Male Port Leaking = Bad Check Valve #64
Check Valve #64 Orange Insert
Check Valve #63 Yellow Insert
Fluid sample port

Figure 72 – UF Fluid Sample / Check Valves

PHT- 1.0.5 CHECK FILLING PROGRAM (FILACT)

a) Referring to the Figure (right), UNPLUG the air sensor's connector from distribution board position labeled "AIR-SEN" (**4th connector cap from the left**). This simulates 'air in chamber #69'.

b) **IMPORTANT!** ALLOW **30 seconds** BEFORE continuing! **FILACT** response in not instantaneous!

c) **ASSURING** the "AIR-SEN" position is EMPTY call debug screen 1. Does **FILACT** = 1?

Yes
a) Return the air sensor's connector to distribution board position labeled "AIR-SEN".
b) Allow 30 seconds and ASSURE **FILACT** = 0 (constant). This indicates the air sensor is plugged in correctly!
c) See procedure number PHT- 2.0.0 (page 193).

No
a) Not likely! ASSURE the air sensor's distribution board position ("AIR-SEN") is EMPTY before continuing! If not, repeat procedure number PHT- 1.0.4 (page 192).
b) After 30 seconds, If (and ONLY if) **FILACT** still = 0, the Filling Program is malfunctioning. Proceed to **page 17**, procedure number **F- 1.0.10**..

PHT- 2.0.0 RESET TMP ALARM

a) ASSURE that the P_{art} and P_{ven} ports (at the Blood Pump and Level Detector modules) are EMPTY!

b) From the Home screen, ASSURE Venous and Arterial Pressure = 0 mmHg.

c) Press and release the 'RESET' key then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. **Ignore temporary Flow Errors during reset!** . If a TMP alarm occurs attempt the RESET sequence up to twice more then continue.

d) Are you able to reset (clear) a TMP alarm?

Yes See procedure number PHT- 2.1.0 (page 193).

No Proceed to **page 178**, procedure number **TMP- 1.0.4**.

PHT- 2.1.0 PRESSURE TESTS

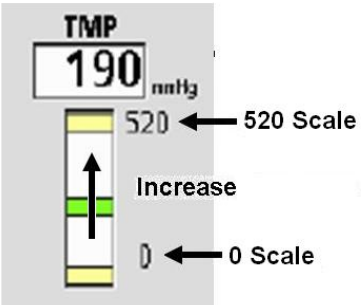
During the "Get Neg TMP" phase of the Pressure Tests the UF pump (#22) strokes about every ten seconds to create negative dialysate pressure. If it reaches its 'target' of greater than -220 mmHg the UF pump stops. Pressure is allowed to stabilize and then the "Neg Flow On" phase begins.

a) Select the screen's 'Test & Options' button. If the 'Pressure Test' button is:

- **Gray (ghosted):** Select the 'Both Tests' button then press the 'CONFIRM' key
- **Blue (active):** Select the 'Pressure Test' button then press the 'CONFIRM' key

b) If 'Both Tests' was selected allow the 'Conductivity' test to complete then allow the "Get Neg TMP" message to appear. If 'Pressure Test' was selected allow the "Get Neg TMP" message to appear.

c) Call the Home screen. Referring to the Figure (right), watch the green 'actual' TMP horizontal bar inside the bar graph. **Ignore the yellow upper and lower alarm limits (respectively at 520 and 0)!**

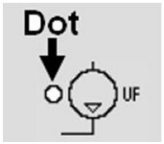


d) After no more than **one minute** (6 UF strokes) does the bar increase (↑) to BETWEEN the 0 and 520 scale reaching 220 mmHg or greater?

Yes See procedure number PHT- 4.0.0 (page 194).

No See procedure number PHT- 2.2.0 (page 194).

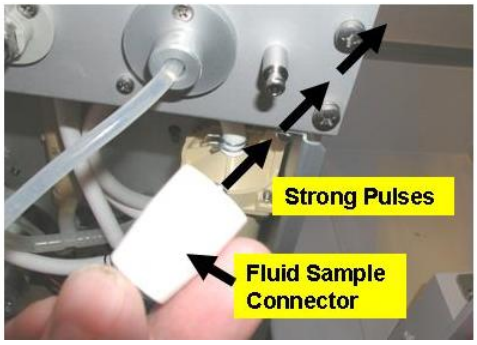
PHT- 2.2.0 CHECK UF PUMP SIGNAL / FLUID OUTPUT



a) Call debug screen 0 and locate the UF pump and its adjacent dot (see Figure right).

b) Referring to the Figure (below, right), remove the Fluid Sample Connector from the Fluid Sample port and position it so that it can be observed.

c) When (and ONLY when) the "Get Neg TMP" message is present AND TMP is less than 220 mmHg AND there are NO alarms the UF dot should blink** white – blue – white, approximately every **10 seconds**.



** **NOTE:** If (and ONLY if) the dot NEVER blinks proceed to **page 215**, **SECTION 14 – UF PUMP PROBLEMS**.

d) When (and **NOT** until) the UF dot blinks white-blue are there 'strong fluid pulses' through the Fluid Sample Connector?

Yes Return the Fluid Sample Connector and see procedure number PHT- 3.0.0 (page 194).

No Proceed to **page 215,** SECTION 14 – UF PUMP PROBLEMS.

PHT- 3.0.0 CHECK TMP INCREASE

Does TMP reach 220 mmHg or greater in one **more** minute or less?

Yes See procedure number PHT- 4.0.0 (page 194).

No a) Turn the machine off and back on.

b) Return to Dialysis Program (remember to press the 'CONFIRM' key) then see procedure number PHT- 5.0.0 (page 195)

PHT- 4.0.0 VERIFY THE PRESSURE TESTS

Allow the tests to complete. **Ignore test Failures above Negative Pressure!** Two scenarios:

1) **Negative and/or Positive Pressure Test FAILS:** See procedure number PHT- 5.0.0 (page 195).

2) **BOTH Pressure Tests (Negative and Positive) PASS**: See procedure number PHT- 4.2.0 (page 194).

PHT- 4.2.0 REPEAT PRESSURE TESTS

From the 'Test & Options' screen, select the 'Pressure Test' button then press the 'CONFIRM' key to repeat Pressure Tests. Two scenarios:

1) **The "Get Neg TMP" message lasts longer than two minutes:** Return to procedure number PHT- 2.2.0 (page 194).

2) **The "Neg Flow On" message appears within two minutes:** Do BOTH pressure Tests (Negative and Positive) pass again?

Yes See procedure number PHT- 4.3.0 (page 194).

No See procedure number PHT- 5.0.0 (page 195).

PHT- 4.3.0 ON LINE PHT FAILURE?

Has the "*On Line PHT Failed*" message occurred more than once during a patient treatment?

Yes See procedure number PHT- 4.4.0 (page 195).

No See procedure number PHT- 9.0.0 (page 200).

PHT- 4.4.0 AUTOMATED VALVE LEAK TESTS ON VALVE #24 AND #25

Valve #24 and/or #25 may be leaking internally:

a) Enter Service Mode → Diagnostics → Valve Leak Test. Allow the [Test Status] data box = "Ready".

b) Select the [Valve Number] data box. It turns bright yellow. Use the up/down arrow keys (K machine) or +/- keys (K^2 machine) until the [Valve Number] data box = Valve #24.

c) Press the 'CONFIRM' key to begin the tests. When complete read the [TEST STATUS] box:

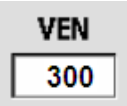
- **"Failed":** Repeat the test. If (and ONLY if) the valve fails again two possibilities: 1) Bad actuator board; 2) Bad (leaking internally) valve. See **Figure 35 A** (page 79) to locate the valve.
- "**Passed":** Repeat PHT- 4.4.0 parts b and c to test Valve #25. If BOTH valves #24 and #25 pass see procedure number PHT- 7.0.0 (page 198).

PHT- 5.0.0 CHECK VENOUS PRESSURE STABILITY

a) Call debug screen 1.

b) Referring to the Figure (right), attach a piece of tubing, with a syringe attached, to the P_{ven} port, at the Level Detector module.

c) Push on the syringe plunger until **VEN** is approximately 300 mmHg then **clamp the syringe**.



d) A decrease of greater than 3 mmHg in 30 seconds may indicate a leak inside the Level Detector module.

e) **IMPORTANT!** Do NOT detach the tubing so that **VEN** remains about 300 mmHg for subsequent procedures.

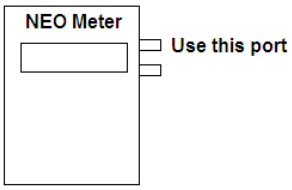
f) See procedure number PHT- 5.1.0 (page 195).

PHT- 5.1.0 CHECK SECONDARY CIRCUIT / CHECK DIALYSATE PRESSURE

a) ASSURE the Bypass LED is off (i.e. flow through the external flow indicator).

b) **IMPORTANT!** Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks).

c) Referring to the Figure (right), attach the four way test assembly to the dialyzer lines. If using a NEO-2 meter attach to the top pressure port.

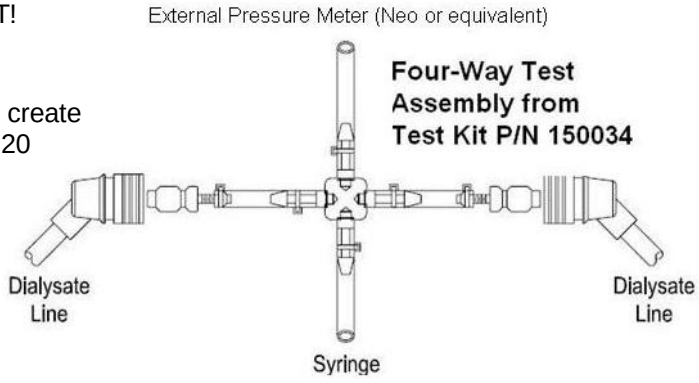


d) Hang the assembly over the dialyzer holder.

e) Assure all assembly connections are TIGHT!

f) **IMPORTANT!** Close the shunt door!

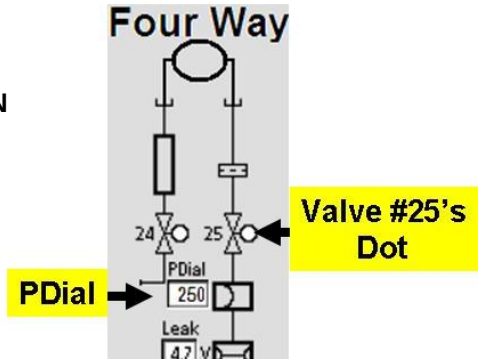
g) Pull on the syringe plunger. Are you able to create approximately -250 mmHg AND hold it (+/- 20 mmHg per minute) on the external meter?



Yes — Clamp the syringe tubing to hold pressure then see procedure number PHT- 5.2.0 (page 196).

No — Remove the tubing from the P_{ven} port and see procedure number PHT- 5.3.0 (page 196).

PHT- 5.2.0 CHECK PDIAL



a) Call debug screen 0. If valve #25's dot is blue (see Figure right) valve #25 is open. Continue to part c. If NOT blue, increase **VEN** (screen 1) until the dot turns blue. If unable, remove the tubing from the P_{ven} port and see procedure number TMP- 6.0.0 (page 187).

b) Monitor the **PDial** window (see Figure right). Two scenarios.

1) **PDial AGREES with the external meter within +/- 25:** See procedure number PHT- 5.6.0 (page 198).

2) **PDial does NOT AGREE with the external meter within +/- 25:** Remove the tubing from the P_{ven} port then proceed to **page 187**, procedure number **TMP- 6.0.0**.

PHT- 5.3.0 ISOLATE SECONARY CIRCUIT (A)

a) **Be CAREFUL HERE!** Referring to Figure 73 A (page 196), DOUBLE clamp the tubing at valve #43's output nozzle (towards the **FRONT** of the machine). Figure 73 B (page 197) illustrates the hydraulic circuit isolation area.

b) Pull on the syringe then clamp the syringe tubing. Can you create approximately -250 mmHg AND HOLD it (+/- 20 mmHg per minute) on the external meter stabilize now?

Yes See PHT- 5.4.0 (page 196).

No See PHT- 5.5.0 (page 197).

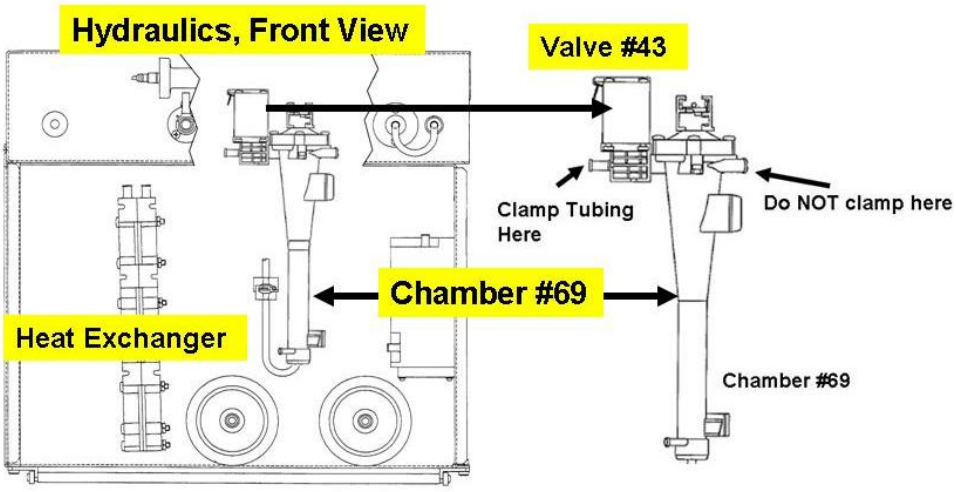


Figure 73 A – Clamping Valve #43

PHT- 5.4.0 ISOLATE VALVE #43 / ACTUATOR BOARD

Two possibilities: 1) Bad actuator board; 2) Bad valve #43. This procedure isolates between the two:

a) Remove the clamps from valve #43's. If valve #43 is leaking the external meter's pressure becomes UNSTABLE again.

b) **IMPORTANT!** From debug screen 1, ASSURE **FILACT** = 0 (constant).

c) Referring to Figure 69 (page 183), touch valve #43's (black) solenoid. Is it warm?

Yes Replace the actuator board (see Figure 4A, page 8).

No Replace valve #43 (leaking).

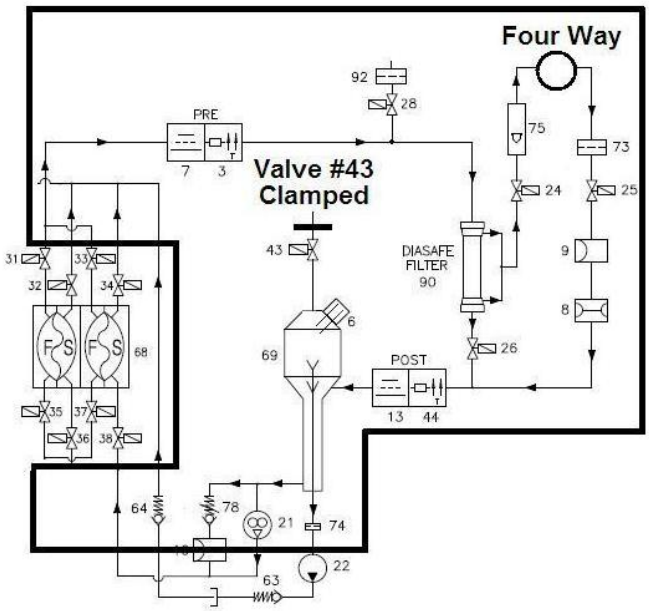


Figure 73 B – Isolation Area A (includes dialysate lines)

PHT- 5.5.0 ISOLATE SECONDARY CIRCUIT (B)

a) Open the shunt door (to close valve #24 and #25). Figure 73 C (page 197) illustrates the isolation area.

b) Pull on the syringe then clamp the syringe tubing. Can you create approximately -250 mmHg AND hold it (+/- 20 mmHg per minute) on the external meter now?

Yes Remove the clamps from valve #43 then see procedure number PHT- 8.1.0 (page 199).

No a) Remove the clamps from valve #43!

b) Two checks: **1)** Check the four way assembly for a leak; **2)** If SURE the four way assembly is NOT leaking proceed see procedure number PHT- 8.1.0 (page 199).

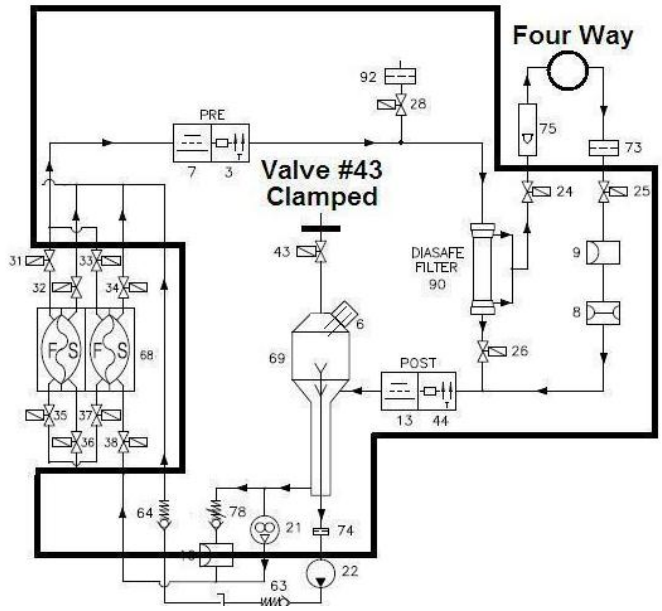


Figure 73 C - Isolation Area B (excludes dialysate lines)

PHT- 5.6.0 CHECK PDIAL AT 0 mmHG / PERFORM POSITIVE TEST

a) Using the syringe set pressure on the external meter to 0 mmHg. If (and ONLY if) **PDial** does NOT = 0 +/- 25 see procedure number TMP- 6.0.0 (page 187).

b) Push on the syringe plunger. Are you able to create approximately +250 mmHg **AND** HOLD it (+/- 20 mmHg per minute) on the external meter?

Yes a) Remove the tubing and syringe from the P_{ven} port.

b) Return the dialyzer lines to the shunt and close the door.

c) See procedure number PHT- 7.0.0 (page 198).

No Remove the tubing and syringe from the P_{ven} port then see procedure number PHT- 8.1.0 (page 199).

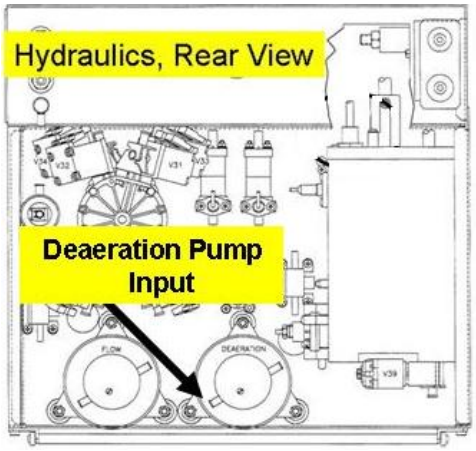
PHT- 7.0.0 CHECK AIR REMOVAL SYSTEM

a) Turn Dialysate flow off (Dialysate flow on/off LED blinks) and allow one minute for the deaeration pump to stop.

b) Referring to the Figure (right), tee a gauge to the INPUT (clear tubing) of the deaeration pump.

c) **IMPORTANT!** Turn Dialysate flow ON (Dialysate flow on/off LED off).

d) Referring to Appendix A (page 260), is Deaeration pressure okay?



Yes See procedure number PHT- 8.0.0 (page 199).

No See procedure number PHT- 7.1.0 (page 198).

PHT- 7.1.0 CALIBRATE DEAERATION PRESSURE

Calibrate DEAERATION AND LOADING PRESSURE per procedure. Is the calibration successful?

Yes See procedure number PHT- 7.2.0 (page 198).

No Proceed to page 211, SECTION 13 - DEAERATION PROBLEMS.

PHT- 7.2.0 REPEAT PRESSURE TESTS

a) Return to Dialysis program (remember to press the 'CONFIRM' key).

b) Allow up to eight minutes for Temperature and Conductivity to stabilize.

c) Call the Home screen and assure Venous Pressure = 0 mmHg.

d) Clear all alarms Select the screen's 'Test & Options' button.

e) Select the 'Both Tests' button then press the 'CONFIRM' key.

f) Allow the tests to complete. **Ignore test Failures above Negative Pressure!** Two scenarios:

1) **Negative and/or Positive Pressure Test FAILS:** See procedure number PHT- 8.0.0 (page 199).

2) **BOTH Pressure Tests (Negative and Positive) PASS**: Repeat the Pressure Tests. If they pass again calibrating deaeration fixed the problem. If (and ONLY if) either fail see procedure number PHT- 8.0.0 (page 199).

PHT- 8.0.0 PERFORM ON-LINE PHT (IF ACTIVE)

This procedure checks the balancing chamber valves for internal leaks using the machine's On Line PHT (Pressure Holding Test) function (if active). Call debug screen 1. Is **NPHT** (upper right) remaining = 720?

Yes On Line PHT is not activated. See procedure number PHT- 8.1.0 (page 199). **NOTE! Fresenius recommends that ONLINE PHT is activated!**

No a) Initiate the test by pressing and holding numeric key pad #1 key for 5 seconds or until **PHTACT** = 1. When **PHTACT** = 0 (test complete) repeat the test by pressing and holding numeric keypad #1 until **PHTACT** = 1.

b) When **PHTACT** = 0 again, from screen 1, check **PHT0** and **PHT1** then refer to Table 22 (page 199).

Table 22 – On Line PHT Results

PHT0	PHT1	Response:
Less than 25	Less than 25	From the 'Test & Options' screen, perform automated Pressure Tests (Negative and Positive) twice. Do they pass? Yes See procedure number PHT- 9.0.0 (page 200). No See procedure number PHT- 8.1.0 (page 199)
Greater than 25	Less than 25	Note this page and procedure number then proceed to page 230, SECTION 18A – AUTOMATED VALVE LEAK TESTS to check balancing chamber valves #31 through #38. If a leak is not located return to PHT- 1.0.0 (page 190).
Less than 25	Greater than 25	Note this page and procedure number then proceed to page 230, SECTION 18A – AUTOMATED VALVE LEAK TESTS to check balancing chamber valves #31 through #38. If a leak is not located return to PHT- 1.0.0 (page 190).
Greater than 25	Greater than 25	**Secondary Volumetric Leak:** See procedure number PHT- 8.1.0 (page 199).

PHT- 8.1.0 TROUBLESHOOT THE SECONDARY SIDE

A. Assure the dialyzer lines are in the shunt and the door is closed.

B. Remove the tubing with syringe (if still attached) from the P_{ven} port.

C. NOTE this procedure and page number in case you need to return here. Proceed until a problem is located:

a) Perform SECTION 12- INDUCED POSITIVE PRESSURE TESTS (page 208) to locate a possible external water leak. If a leak is not located continue with PHT- 8.1.0 part b. **If a leak is located this may be the problem!**

b) Perform SECTION 11- INDUCED AIR LEAK TESTS (page 202) to locate a possible hydraulic air leak. If an air leak is not located continue with PHT- 8.1.0, part c. **If a leak is located this may be the problem!**

c) Replace the DiaSafe® filter per procedure then repeat the automated Pressure (Negative and Positive) Tests. If they do NOT pass continue with PHT- 8.1.0, part d.

d) **NOTE** nine leak tests will be performed: **1)** IOS; **2)** Balancing Chamber Valves #31 through #38. See SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

e) After repairs and the Pressure Tests pass perform also procedure number PHT- 9.0.0, UF INTEGRITY CHECK (page 200).

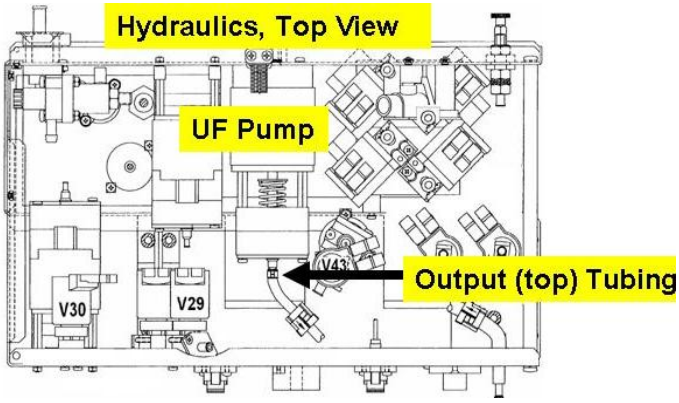
PHT- 9.0.0 UF INTEGRITY CHECK

This procedure checks that the UF pump internal springs are functioning properly:

a) Referring to the Figure (right), remove the OUTPUT tubing from the UF pump.

b) Attach a 24 inch piece of tubing to the empty nozzle and direct it away from the machine. The UF pump will output fluid during subsequent tests.

c) From the 'Test & Options' screen repeat the Pressure Tests. Do both (Negative and Positive) Pressure tests pass?



Yes Reinstall the tubing. A Pressure Test problem is not indicated at this time however, per Preventative Maintenance procedures check UF PUMP (1 ml/stroke). **NOTE: If Pressure Tests are failing intermittently consider replacing the DiaSafe® filter per procedure.**

No CAREFULLY rebuild the UF Pump per Preventative Maintenance Procedures then repeat the UF INTEGRITY CHECK.

PHT- 10.0.0 DIASAFE® FILTER TEST VALVE CHECKS

Referring to Figure 301 (page 200), proceed according to how the machine is equipped:

- **Valve #28 (with DiaSafe® Plus Filter):** See procedure number PHT- 10.2.0 (page 201).
- **Valve #91 (with old style DiaSafe® filter):** Replace valve #91.

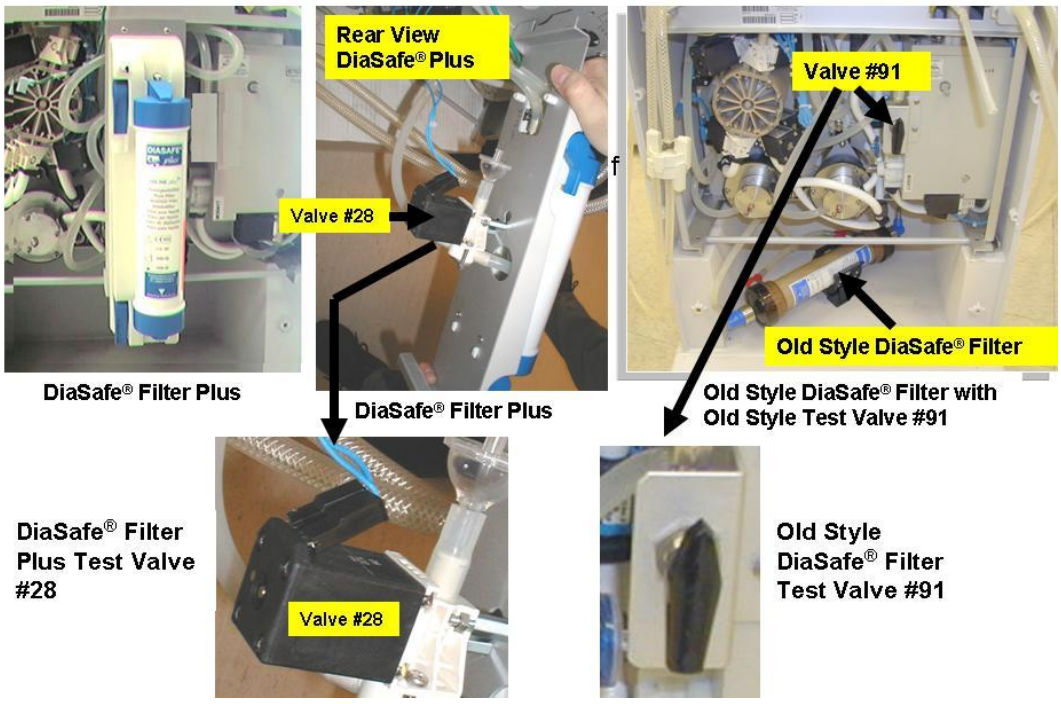


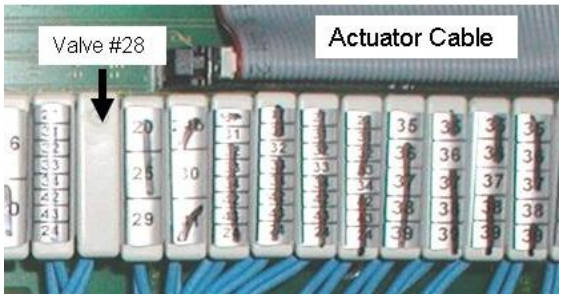
Figure 301 – DiaSafe® Options

PHT- 10.2.0 CHECKING VALVE #28

Referring to the Figure (right), unplug valve #28 from the distribution board. Does the valve continue to leak?

Yes Replace valve #28 (leaking).

No Replace the actuator board (see Figure 4A, page 8).



Automated Pressure Test Theory:

A leak in the secondary hydraulic circuit compromises accurate fluid (UF) removal. The following discussion describes how the automated Pressure Tests are performed.

With the balancing chamber (BC) valves cycling normally and the flow pump running the **Automated Pressure Tests** (Negative Pressure, Positive Pressure) begin with "Get Neg TMP". During this time the UF pump #22 strokes until a 'target' of approximately -240 mmHg (TMP = 240 mmHg) is achieved as monitored by the dialysate pressure transducer #9. This normally takes less than one minute. When target pressure is reached the UF pump stops. After a stabilization period **"Neg Flow On"** begins and runs for one minute. If pressure remains stable (+/- 20 mmHg) the test passes. Next all four 'fresh side' BC valves open briefly to drive positive (loading) pressure into the secondary circuit. At this point all eight BC valves are closed and the flow pump (#21) stops. Because target pressure (approximately +300 mmHg) is overshot the UF pump strokes, two to four times, until target is achieved. After a stabilization period **"Pos Flow Off"** starts and runs for one minute. If pressure remains stable (+/- 30 mmHg) the test passes.

Probable Causes of Automated Pressure Test Failures (Neg Flow On, Pos Flow Off):

- UF Pump cannot create target negative pressure
- Air entering or water escaping through a bad o-ring, bad connection, tubing leak, etc.
- Dialysate Pressure (or Transmembrane Pressure (TMP) out of calibration specifications)
- If equipped, DiaSafe® filter leaking or DiaSafe® filter test valve leaking internally
- Deaeration pressure too high or too low
- Valve #43 leaking internally
- Balancing chamber valve (#31 through #38) leaking internally

The **On Line Pressure Holding Tests (On Line PHT)**, if activated, are performed automatically every 12 minutes (720 seconds) regardless of other alarm conditions. These tests monitor the current dialysate pressure (i.e. pressure is not created as it is during Negative Flow On/Positive Flow Off Pressure Tests). Dialysate flow is momentarily defaulted to 500 ml/min, valve #26 opens and valves #24 and #25 close (to isolate the dialyzer, if attached). Dialysate pressure is monitored for two consecutive balancing chamber cycles, approximately 7.2 seconds. If pressure remains stable (+/- 30 mmHg) the On Line PHT passes.

Probable Causes of On Line PHT Failures:

- Air entering or water escaping through a bad o-ring, bad connection, tubing leak, etc.
- If equipped, DiaSafe® filter leaking or DiaSafe® filter test valve leaking internally
- Valves #43, #24, #25 leaking internally
- Balancing chamber valve (#31 through #38) leaking internally
- Deaeration pressure too high or too low
- Dialysate Pressure (or Transmembrane Pressure (TMP) out of calibration specifications)

SECTION 11 – INDUCED AIR LEAK TESTS

These tests use negative pressure in an effort to locate a potential air leak. Checks start at the most convenient location (post dialysate line filter #73) and continue upstream. **BE THOROUGH! USE A FLASHLIGHT!** Watch each area for at least 30 seconds as sometimes air will group and release intermittently. **IMPORTANT NOTE!** In some cases, small air bubbles may be 'normal'. Check another machine that is passing pressure tests, to determine what 'normal' looks like.

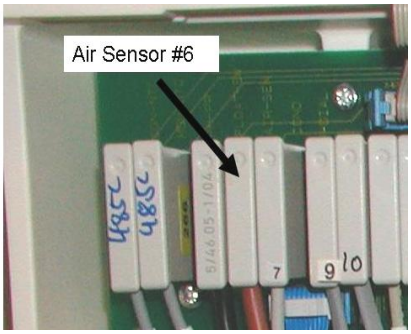
A. Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

B. Place both dialyzer quick connects into the shunt and close the door.

C. **IMPORTANT!** Allow five minutes for stabilization.

D. Call debug screen 0. If **Flow Error** = 1 do NOT perform these tests!

E. Call debug screen 1. If (and ONLY if) **FILACT** = 1 place one of the resistor plugs, from the four-resistor Temperature set, into the air sensor's distribution board position labeled "AIR-SEN" (**4th connector cap**, **from the left**). See Figure (right).



F. Allow 30 seconds, **FILACT** should = 0 constant.

G. See procedure number AIR 1.0.0 (page 202).

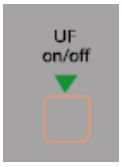
AIR- 1.0.0 PERFORM MANUAL PRESSURE TEST

a) RESET ALL blood alarms (a conductivity alarm can be ignored).

b) Call the Home screen. Set UF GOAL to 3000 ml/hour; set UF RATE to 750 ml/hr.

c) Press the UF on/off key (front panel) to turn the UF pump on (i.e. UF on/off LED on).

d) Allow TMP to increase to 180 mmHg then **turn UF off** (green UF on/off LED off).



e) Allow 20 seconds for stabilization. TMP should be no greater **240 mmHg** to continue.

f) Watch TMP for two minutes. Does it remain stable (+/- 60 mmHg)?

Yes An air leak is not indicated:

a) Return the air sensor's connector to distribution board position "AIR-SEN" (**5th position from the left**).

b) If referred to INDUCED AIR LEAK TESTS return to the procedure that brought you here.

No See procedure number AIR 1.0.1 (page 202).

AIR 1.0.1 CHECK FOR AN AIR LEAK

a) RESET all alarms. If TMP is below 160 mmHg turn UF on until it increases to 180 mmHg*.

* NOTE: If TMP falls below 160 mmHg during these tests turn UF on momentarily to bring it back up. **TMP should be maintained between 160 and 240 mmHg**.

b) Referring to Figure 75 (page 204), check through the Flow Pump's (clear) input tubing for an air leak.

c) Assure the shunt door is closed!

d) Referring to Figure 74 (page 203), check through the OUTPUT tubing (Into Machine) of dialysate filter (#73). This is **Location #1 (L1)** referring to the abbreviated flow diagram (Figure 74). Are large air bubbles seen at L1?

Yes See procedure number AIR- 1.0.2 (page 203).

No See procedure number AIR- 1.0.3 (page 205).

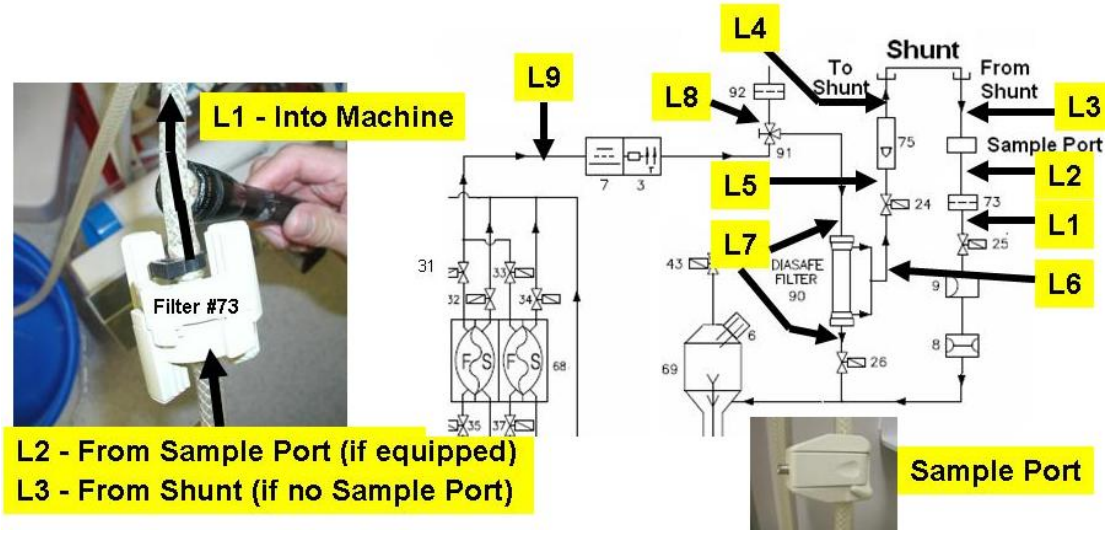


Figure 74 – Leak Checks (1) / Abbreviated Flow Diagram

AIR- 1.0.2 TRACE UPSTREAM FROM FILTER

Per Table 23 (page 203), and assuring that **TMP is between 160 and 240 mmHg**, continue checking upstream starting at Location #2 (L2) until large air bubbles are no longer seen.

Table 23 – Air Checks (1)

Location #	Description	If NO is air is seen, the leak is at:	If air is seen go to:
L2	From Shunt door or optional Sample Port (Figure 75, page 204)	Dialysate filter #73	L3 if equipped with Sample Port, L4 if not.
L3	From Shunt door (Figure 75, page 204)	The Sample Port	L4
L4	To Shunt door (Figure 75, page 204)	Dialyzer connector(s) or o-ring(s)	L5
L5	Bottom of Flow Indicator #75 (Figure 75, page 204)	Flow indicator #75	L6
L6	Input Valve #24 / Valve #26 mounting block (Figure 76, page 204).	Valve #24 / Valve #26 mounting block	L7 if DiaSafe® filter equipped, L9 if not
L7	Input DiaSafe® Filter #90	DiaSafe® filter #90	L8
L8	After Conductivity Cell #7 / NTC #3 (Figure 75, page 204)	DiaSafe® Test Valve (#91 Old style DiaSafe®, #28 DiaSafe® Filter Plus)	L9
L9	Before Conductivity Cell #7 / NTC #3 (Figure 75, page 204)	Conductivity Cell #7 or NTC #3	See procedure number AIR 1.0.5 (page 206)

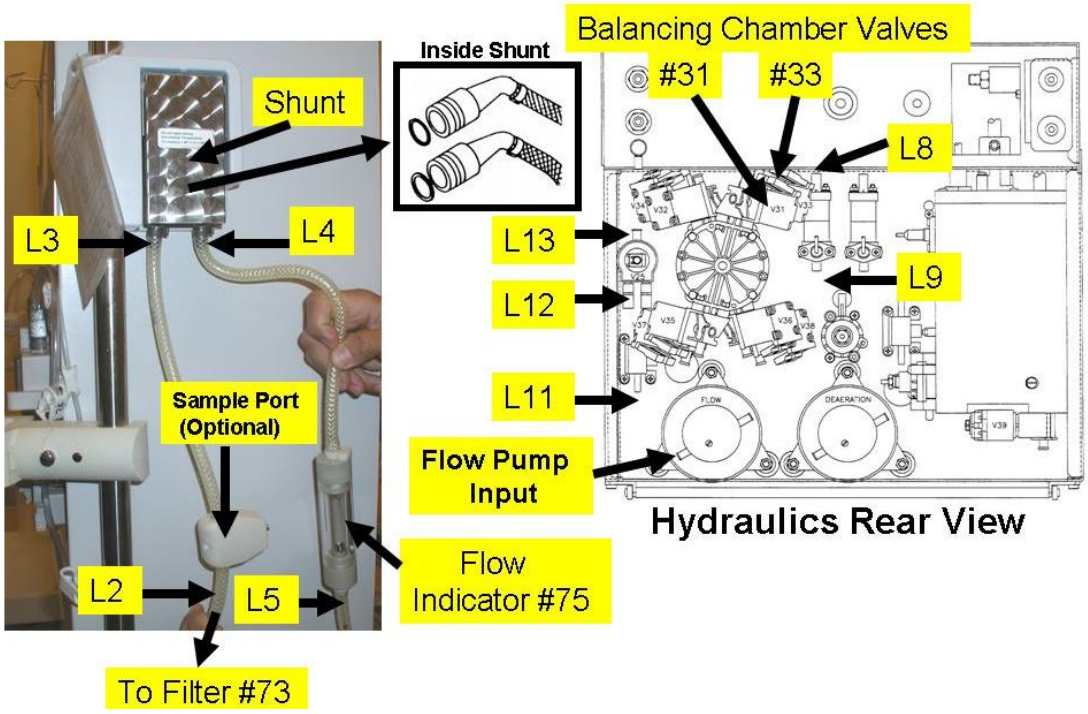


Figure 75 – Hydraulics (External & Rear Views)

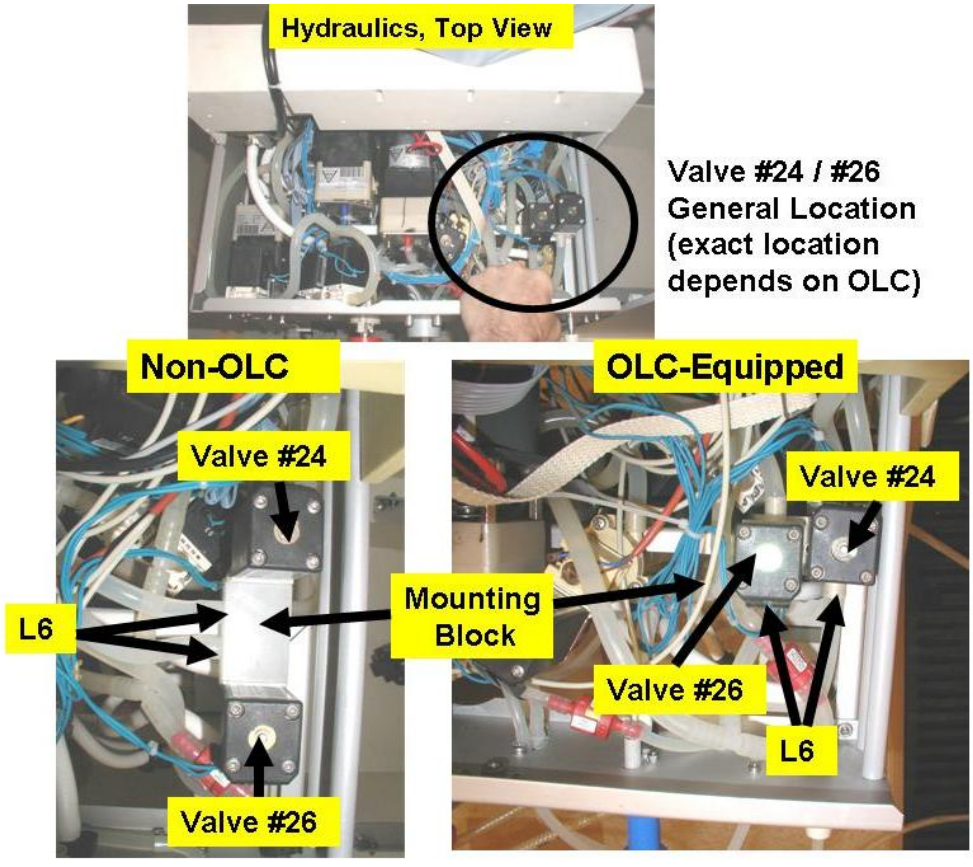


Figure 76 – Hydraulics (Top View)

AIR- 1.0.3 CHECK FOR AIR INPUT CHAMBER #69

Referring to Figure 77 (page 205), and assuring that **TMP is between 160 and 280 mmHg**, check through the INPUT tubing at the **rear side** (NOT the tubing at valve #43!) of air removal chamber #69. This is Location #10 (L10), referring to abbreviated flow diagram (Figure 77). Are large air bubbles seen at L10?

Yes See procedure number AIR-1.0.4 (page 205).

No An air leak cannot be detected! If referred to INDUCED AIR LEAK TESTS return to the procedure that brought you here.

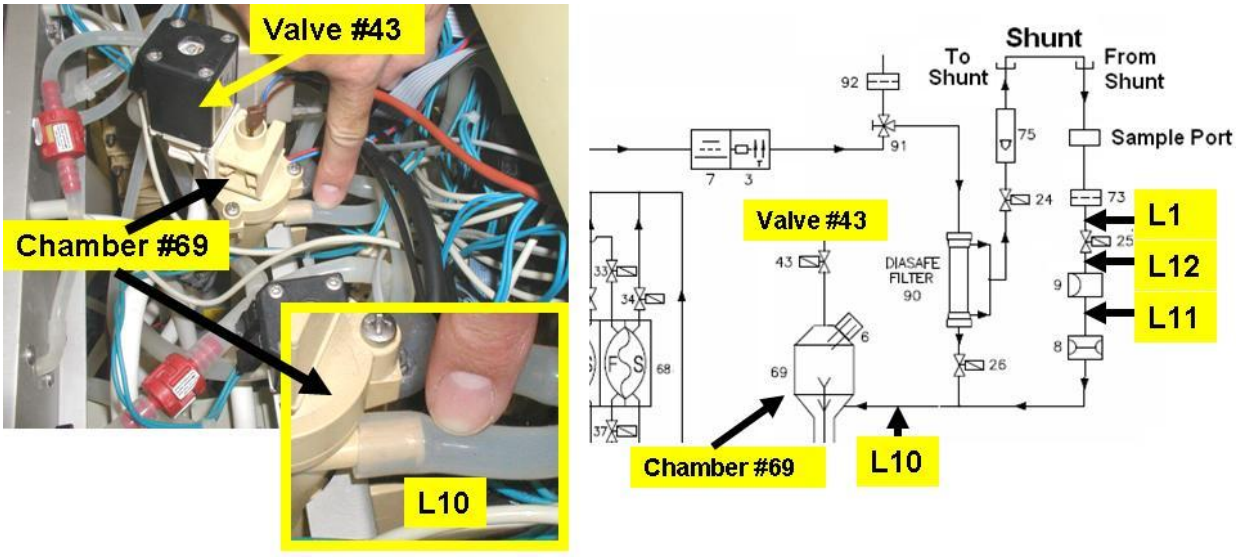


Figure 77 – Leak Checks (2) / Abbreviated Flow Diagram

AIR- 1.0.4 TRACE UPSTREAM FROM CHAMBER #69

Per Table 24 (page 205), and assuring that **TMP remains between 160 and 240 mmHg**, continue checking upstream starting at Location #11 (L11) until large air bubbles are no longer seen.

Table 24 – Air Checks (2)

Location #	Description	If NO is air seen, the leak is at:	If air is seen go to:
L11	Input Blood Leak Sensor #8 (Figure 75, page 204)	Blood Leak Sensor #8	L12
L12	Output Valve #25 (Figure 75, page 204)	Dialysate Pressure Transducer #9	L1
L1	Input Valve #25 (Figure 75, page 204)	Valve #25	See procedure number AIR- 1.0.2 (page 203).

AIR- 1.0.5 AIR LEAK FROM BALANCING CHAMBER

Air bubbles seen at the Conductivity cell:

Referring to Figure 78 (page 206), watch CAREFULLY through the tubing at both valves. Is air coming from **ONE** or **BOTH** valves?

ONE a) Check the connection (and o-ring) between the valve and the balancing chamber body.

b) Check the valve body for cracks.

BOTH See procedure number AIR- 1.0.6 (page 206).

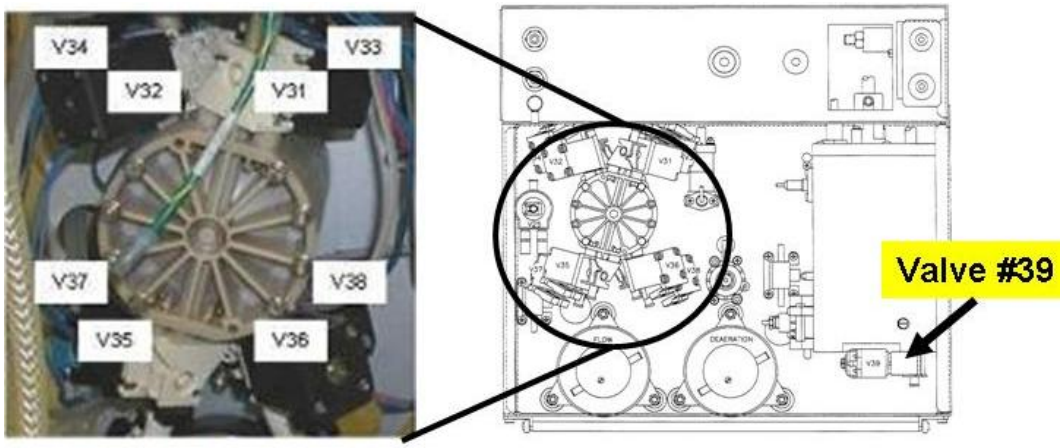


Figure 78 – Balancing Chamber Valves / Valve #39

AIR- 1.0.6 CHECK CONCENTRATE INLET SYSTEMS

Referring to Figure 79 (page 206), and using a flashlight, CAREFULLY check through the inlet bicarbonate and acid tubing. Are air bubbles seen?

Yes a) Check and/or replace all o-rings at the leaking connector (see Figure 79).

b) If using jugs, check the concentrate wand(s). See Figure right.

c) Check the connector(s) for cracks.

No See procedure number AIR- 1.0.7 (page 207).

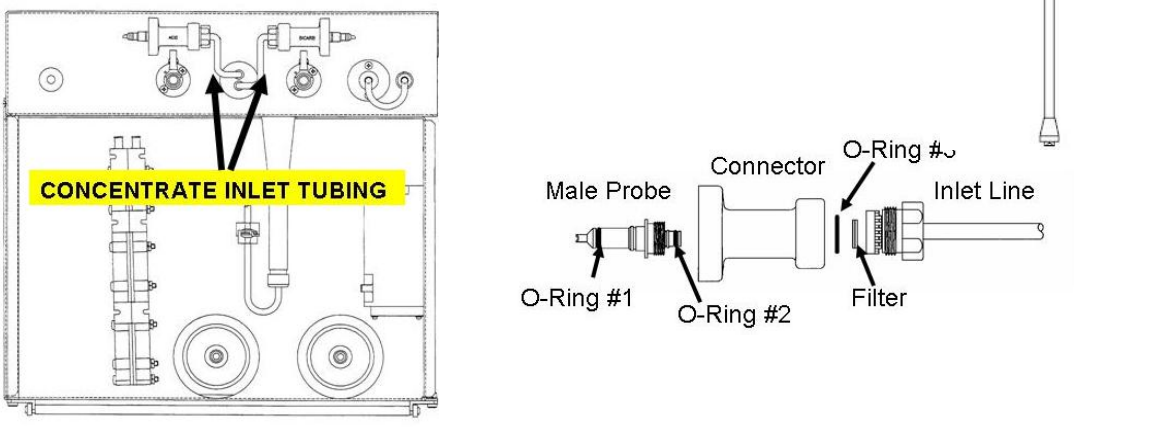


Figure 79 – Concentrate Inlet Systems

AIR- 1.0.7 CHECK VALVE #39 / HYDROBLOCK OR HYDRO CHAMBER

a) Referring to Figure 78 (page 206), check that the bracket that mounts valve #39 to the bottom of the hydro block / hydro chamber is tight (two screws). **If the bracket is loose this is the problem!**

b) Refer to Appendix A (page 260), check Deaeration Pressure per **Preventative Maintenance Procedures**. If necessary, calibrate LOADING and DEAERATION PRESSURE. If (and ONLY if) the calibration is unsuccessful, see SECTION 13 – DEAERATION PROBLEMS (page 211).

c) Proceed according to how the machine is equipped (**Old Style Hydro Block** or **New Style Hydro Chamber** (see Figure 2B, page 4):

- **Old Style Hydro Block:** See procedure number AIR- 1.0.8 (page 207).
- **New Style Hydro Chamber:** See procedure number AIR- 1.0.9 (page 207).

AIR- 1.0.8 CHECK HYDRO BLOCK

a) Turn the machine off and clamp the vent tubing (see Figure 6, page 13).

b) Referring Figure 84 (page 212), remove the restrictor fitting and check or replace **BOTH** o-rings (P/N 579070). These o-rings affect pressures and should be replaced during Annual Preventative Maintenance.

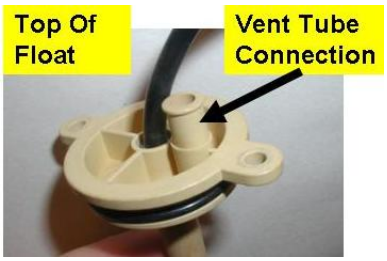
c) Reinstall the restrictor and tighten it until snug only. **Never use an electric screwdriver!** If it won't tighten, the threads may be stripped and this probably requires replacing the hydro block.

d) See procedure number AIR- 1.0.9 (page 207).

AIR- 1.0.9 LEAK TEST HYDRO BLOCK/HYDRO CHAMBER

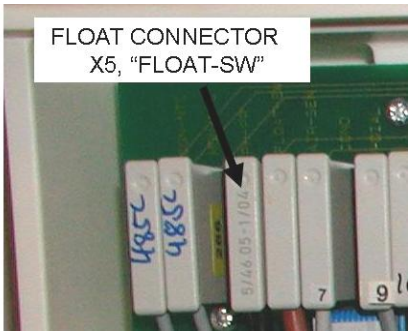
This procedure pressurizes the Hydro Block/Hydro Chamber to locate a potential external water leak. A clamp and the **274 Ω** resistor plug from the two-resistor OLC set, is required:

a) Referring to the Figure (right), at the top of the Hydro Block/Hydro Chamber, tie wrap the segment of vent tubing that is attached to the float.



b) Referring to the Figure (below, right), place the **274 Ω** plug, from the two-resistor OLC set, into the float's distribution position labeled "FLOAT-SW" (**3rd connector, from the left**). This simulates a closed float switch and opens incoming water valve #41.

c) If the **274 Ω** plug is placed correctly vent tubing overflow occurs within 30 seconds.



d) **Clamp** the vent tubing. This pressurizes the Block/Chamber to approximately 20 psi (per incoming water regulator #61).

e) Watch the top and bottom of the Block/Chamber. Water leak located?

Yes Proceed to **page 214**, procedure number **DAIR- 7.0.0**.

No a) Return the float connector to distribution board position "FLOAT-SW" and unclamp the vent tubing.

b) Return to AIR 1.0.1 (page 202).

SECTION 12 – INDUCED POSITIVE PRESSURE TESTS

During these procedures (10 steps), hydraulic systems are checked for external water leaks. **USE A FLASHLIGHT! BE THOROUGH! FEEL AROUND!** Leaks can be VERY small and take several minutes to become obvious! **If a leak if found this may be the problem!**

1. Place the dialyzer connectors into the shunt and close the door.
2. Plug the concentrate connectors into their respective rinse ports.
3. Place the machine into Rinse Program.
4. Referring to Figure 80 (page 208) check for leaks inside the hydraulic drawer but especially at: **1)** Air removal chamber #69; **2)** Filter #74; **3)** UF pump #22; **4)** Valve #78 (Figure 81, page 208). If (and ONLY if) no leaks are located see step 5.
5. Referring to Figure 81 (page 208), check for leaks at the: **5)** Dialyzer Quick Connects and o-rings; **6)** External Flow Indicator #75; **7)** Dialysate Line Filter #73; **8)** (Optional) Fluid Sample Port; **9)** Dialysate line connections at the rear of the machine. If no leaks are located see step 6.

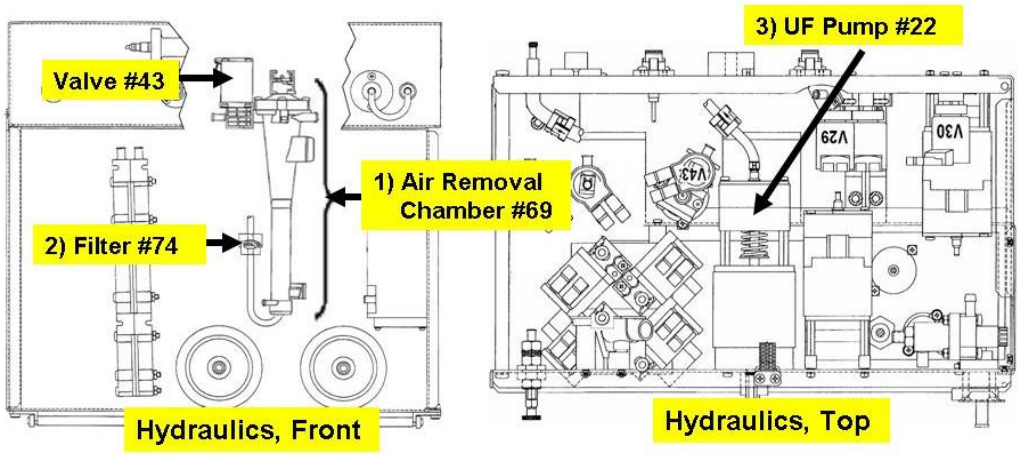


Figure 80 – Internal Dialysate Circuit Leak Checks

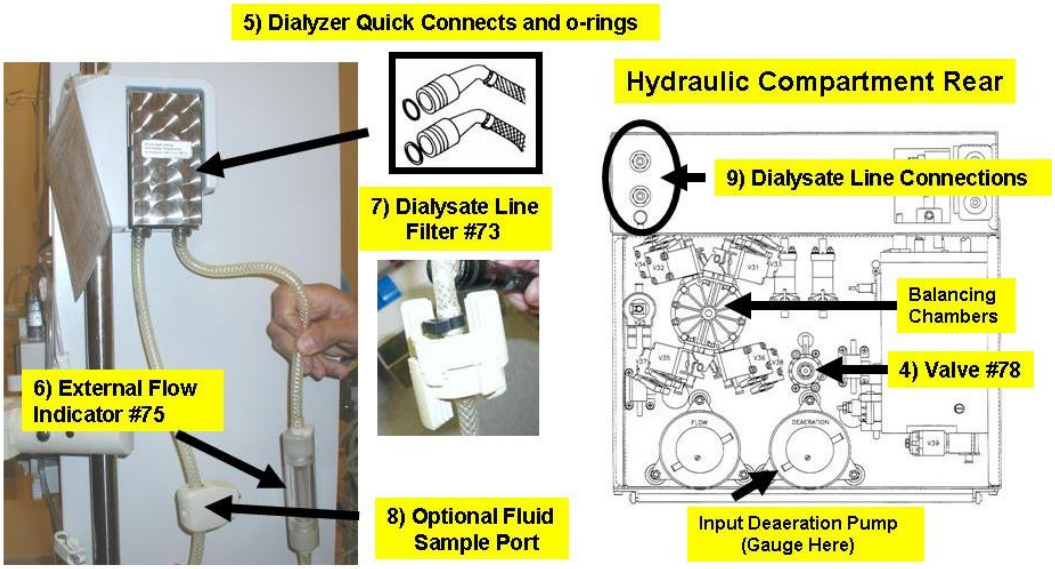

5) Dialyzer Quick Connects and o-rings
Hydraulic Compartment Rear
9) Dialysate Line Connections
7) Dialysate Line Filter #73
Balancing Chambers
4) Valve #78
6) External Flow Indicator #75
8) Optional Fluid Sample Port
Input Deaeration Pump (Gauge Here)

Figure 81 – External Dialysate Circuit Leak Tests

6. Referring to Figure 82 (page 211), proceed according to how the machine is equipped:
   - **DiaSafe® Plus filter:** Remove the plastic cover and check the headers. If no leaks are located see step 7
   - **Old style DiaSafe® filter:** Check especially at and below ALL four (red and blue) quick connectors and filter headers. If no leaks are located see step 7
   - **NOT equipped with DiaSafe® filter:** See step 7

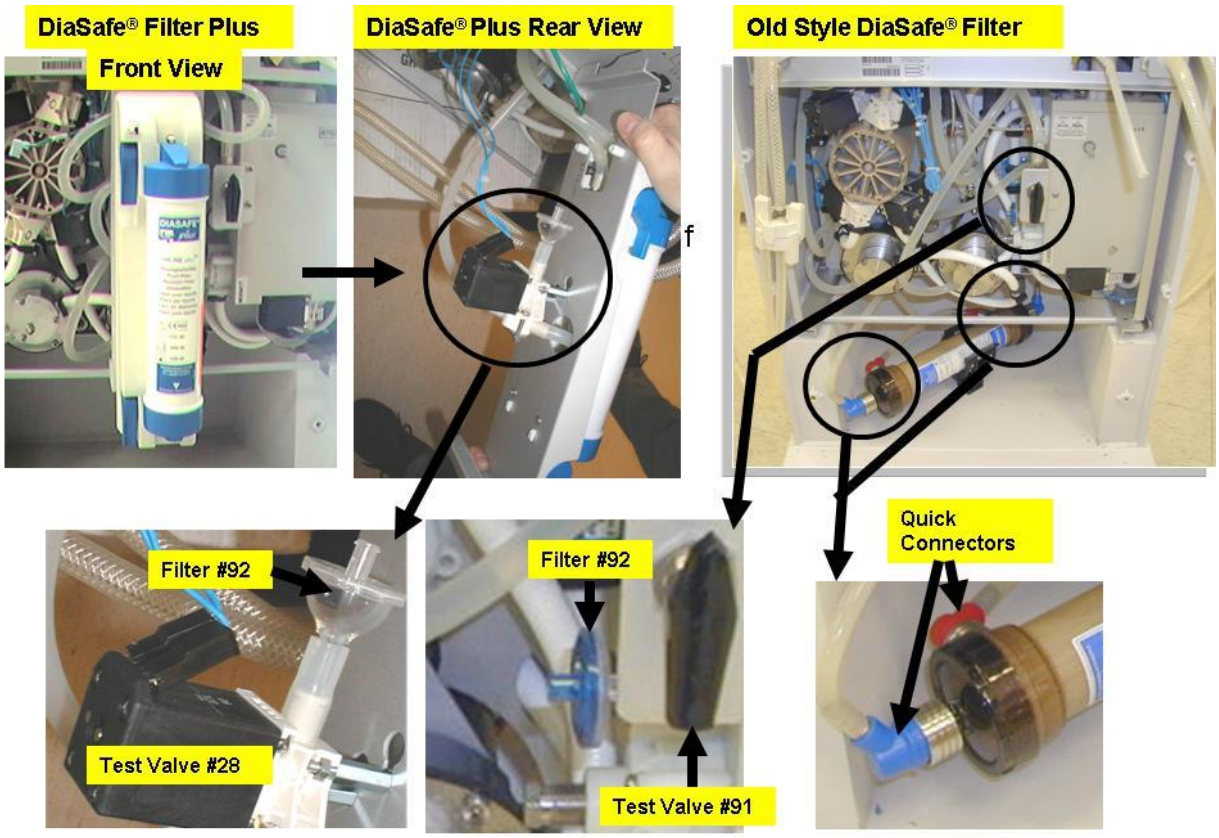


Figure 82 – DiaSafe® Filter Leak Tests

7. Allow five minutes then REPEAT parts 4 through 6 to locate a 'slow developing' leak. **If a leak is located this is probably the problem!** If no leaks are located see step 8.
8. Referring to Figure 82 (page 211), remove filter #92 from the DiaSafe® filters "Test Valve". Is the 'Test Valve' leaking? **IMPORTANT NOTE!** In some cases the Old Style DiaSafe® Filter may have been removed but Test Valve #91 remains installed. In this event this test should be performed.

   Yes Proceed accordingly (depending on **DiaSafe® Plus** or **Old Style DiaSafe®** filter):
   - **Valve #28 (DiaSafe® Plus Filter):** See procedure number INDUCED- 1.0.0, (page 210).
   - **Valve #91 (old style DiaSafe® filter):** Replace valve #91.

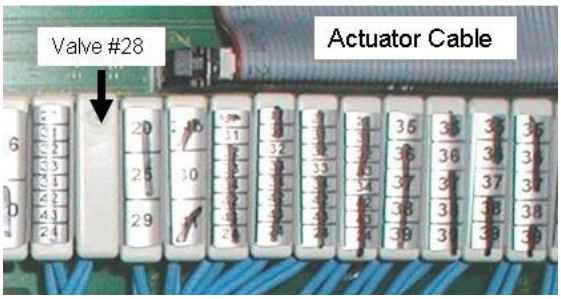
   No Reattach filter #92 then see step 9.
9. Connect to concentrate and return to Dialysis program (remember to press the 'CONFIRM' key).
10. If referred to INDUCED POSITIVE PRESSURE TESTS return to the procedure that brought you here.

INDUCED- 1.0.0 CHECKING VALVE #28

Referring to the Figure (right), unplug valve #28 from the distribution board. Does the valve continue to leak?

Yes Replace valve #28 (leaking).

No Replace the actuator board (see Figure 4A, page 8).



SECTION 13 - DEAERATION PROBLEMS

These procedures are used when target deaeration pressure cannot be achieved per Appendix A (page 260).

DAIR- 1.0.0 CHECK DIALYSIS PROGRAM

a) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

b) **IMPORTANT!** Assuring Dialysate flow in ON (Dialysate Flow on/off LED off) call debug screen 1. **FLWP** (upper right) is (two possible scenarios):

1. **255 constant:** Momentarily place the machine into Rinse program then repeat procedure number DAIR- 1.0.0. If you return here (because FLWP = 255 constant) two possibilities: 1) Bad actuator board; 2) Bad function board.
2. **All others:** See procedure number DAIR- 1.0.1 (page 211).

DAIR- 1.0.1 CHECK DEAERATION MOTOR

a) **IMPORTANT!** If Automated Tests start (screen reads "Test …") at ANY time allow them to complete! Automated Testing, while troubleshooting, may cause misdiagnosis! IGNORE all test fail messages for now!

b) Remove the 'venous dummy chamber' from the Level Detector module to prevent 'Forced Test' from starting.

c) Referring to Figure 83 (page 211). Is the deaeration motor shaft rotating?

Yes See procedure number DAIR- 1.0.2 (page 211).

No **NOTE** a problem with the **DEAERATION MOTOR** ONLY and proceed to **page 60**, TROUBLESHOOTING MOTORS

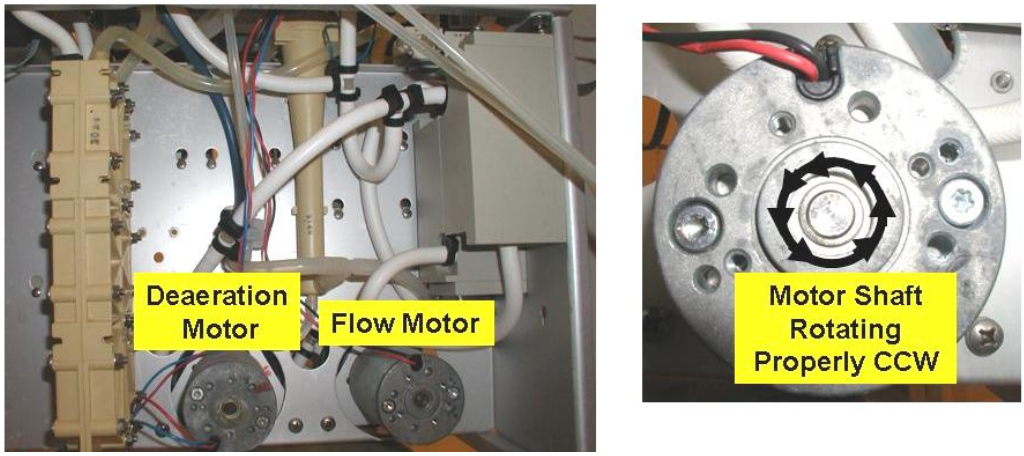


Figure 83 – Hydraulics (Front View) / Deaeration Motor

DAIR 1.0.2 CHECK FOR LARGE HYDRAULIC LEAKS

Check the hydraulic drawer and the DiaSafe® filter (if equipped). Is a LARGE external water leak located?

Yes Proceed to **page 248**, SECTION 21- LARGE HYDRAULIC LEAKS.

No See procedure number DAIR- 1.0.3 (page 212).

DAIR- 1.0.3 CHECK FLOW ERROR

Call debug screen 0 and CAREFULLY watch **Flow Error** for three minutes. Proceed accordingly:

- **Flow Error = 1 (constant or intermittent):** Proceed to **page 14**, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM.
- **Flow Error = 0 (constant):** See procedure number DAIR- 2.0.0 (page 212).

DAIR- 2.0.0 CHECK RESTRICTOR (#48)

Referring to Figure 84 (page 212), is the machine equipped with the **New Style Hydro Chamber** or **Old Style Hydro Block**?

Hydro Chamber:

a) Turn the machine off and clamp the vent tubing externally and at the tee back to the hydro chamber (see Figure 6, page 13).

b) Remove the external tubing that contains restrictor #48 (a glass segment).

c) Attach a syringe and push or pull on the plunger. If the plunger resists the restrictor IS plugged (maybe partially) with debris.

d) Reinstall the tubing then see procedure number DAIR- 3.0.0 (page 213).

Hydro Block:

a) Turn the machine off and clamp the vent tubing (see Figure 6, page 13).

b) Check or replace **BOTH** restrictor o-rings (P/N 579070). These o-rings affect pressures and should be replaced during Annual Preventative Maintenance.

c) Check the restrictor on both sides for debris.

d) Reinstall the restrictor and tighten it until snug only. **Never use an electric screwdriver!** If it won't tighten, the threads may be stripped and this requires replacing the hydro block.

e) See procedure number DAIR- 3.0.0 (page 213).

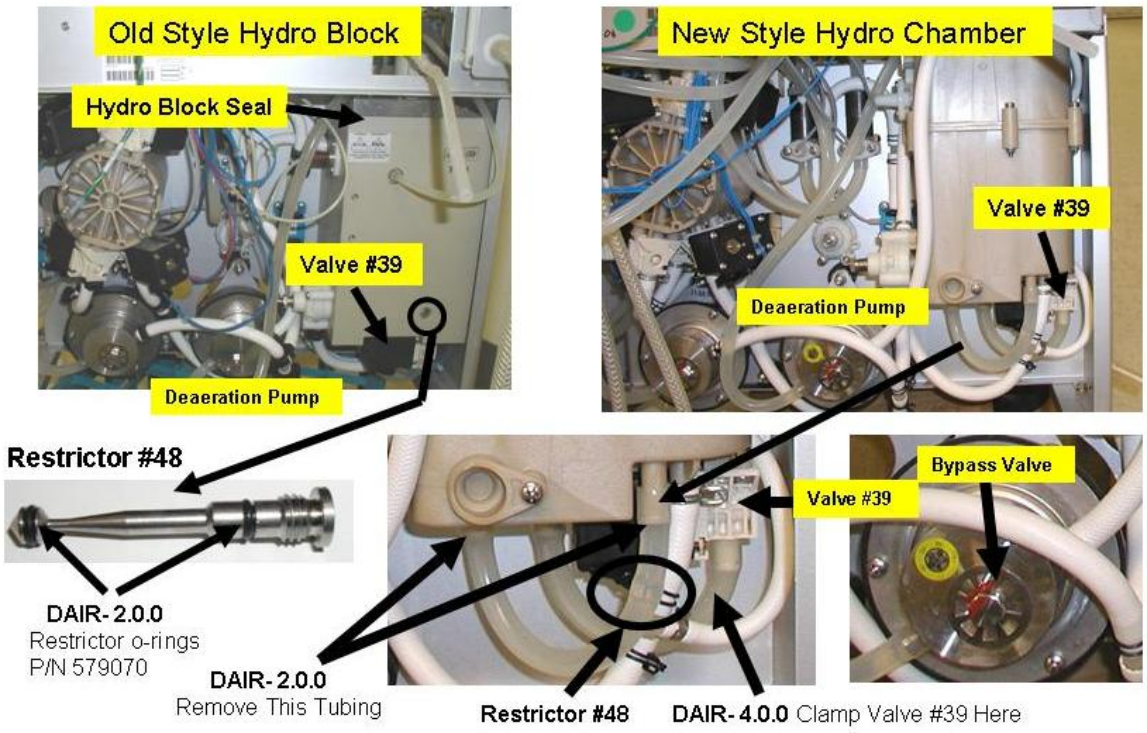


Figure 84 – Hydro Block/Hydro Chamber

DAIR- 3.0.0 CHECK ACTUATOR BOARD CONTROL

a) **IMPORTANT!** Remove the clamp(s) from the vent tubing and assure the water is on.

b) Enter Service Mode → Calibrate Hydraulics → Deaeration.

c) Select the [Pump Rate] data box. The data box turns bright yellow.

d) Set the [Pump Rate] data box to "0".

e) **IMPORTANT!** Press the 'CONFIRM' key. The [Pump Rate] data box turns pale yellow.

f) Referring to Figure 82 (page 211), is the deaeration motor shaft rotating?

Yes Replace the actuator board (see Figure 4A, page 8).

No DAIR- 3.0.1 (page 213).

DAIR- 3.0.1 ATTEMPT CALIBRATION

a) Referring to Appendix A (page 260), attempt Deaeration and Loading Pressure calibration per procedure. **IMPORTANT! Press the 'CONFIRM' key after each adjustment of the [Pump Rate]* data box. *NOTE: [Pump Rate] values should be no less than 180 or no greater than 215!**

b) Are you able to achieve target deaeration pressure without exceeding 215?

Yes Problem solved!

No Do NOT press the 'CONFIRM' key (i.e. do NOT save the calibration)! See procedure number DAIR- 4.0.0 (page 213).

DAIR- 4.0.0 ISOLATE VALVE #39

This procedure checks if valve #39 is 'stuck' open causing low deaeration pressure:

a) Referring to Figure 84 (page 212), valve #39 is mounted at the bottom of the Hydro block or Hydro chamber. TIGHTLY double clamp its **clear** tubing at the **location specified** in Figure 84.

b) Attempt Deaeration and Loading Pressure calibration. **IMPORTANT! Press the 'CONFIRM' key after each adjustment of the *[Pump Rate] data box.** Are you able to achieve target deaeration pressure without exceeding 215?

Yes Do NOT press the 'CONFIRM' key (i.e. do NOT save the calibration)! See procedure number DAIR- 4.0.1 (page 213).

No See procedure number DAIR- 5.0.0 (page 214).

DAIR- 4.0.1 ISOLATE VALVE #39 / ACTUATOR BOARD

Remove valve #39's clamps. Does deaeration pressure remain at target?

Yes Press the 'CONFIRM' key to save the calibration. Problem solved

No Do NOT press the 'CONFIRM' key. See procedure number DAIR- 4.0.2 (page 213).

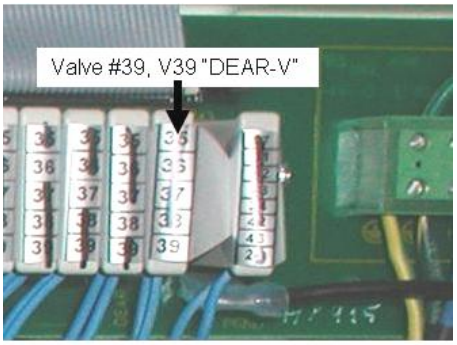
DAIR- 4.0.2 ISOLATE ACTUATOR BOARD / VALVE #39

a) Referring to the Figure (right), unplug valve 39 from distribution board position V39, "DEAR-V" (**2nd connector from the right**).

b) Does deaeration pressure remain at target?

Yes Replace the actuator board.

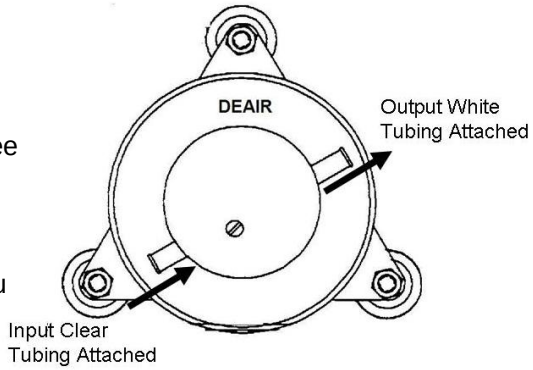
No Replace valve #39 (leaking).



DAIR- 5.0.0 ISOLATE THE DEAERATION PUMP HEAD

a) **IMPORTANT!** Remove valve #39's clamps.

b) Referring Figure 84 (page 212), swap in a known good deaeration pump head. Make sure to orient it correctly (see Figure right).



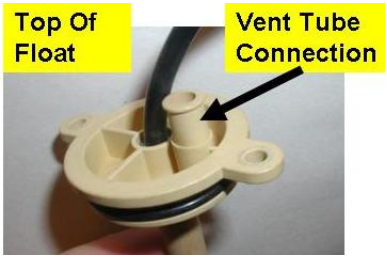
c) Attempt Deaeration and Loading Pressure calibration. **IMPORTANT! Press the 'CONFIRM' key after each adjustment of the [Pump Rate] data box value**. Are you able to achieve target deaeration pressure without exceeding 215?

Yes Problem solved! The previous pump head is bad.

No See procedure number DAIR- 6.0.0 (page 214). **The previous pump head is probably good.**

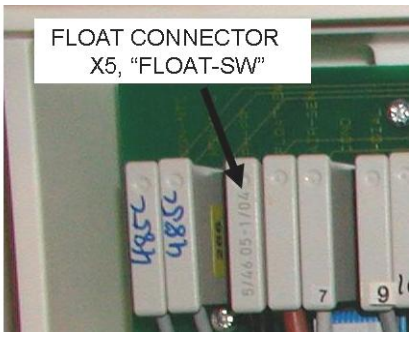
DAIR- 6.0.0 PRESSURE TEST HYDRO BLOCK/ HYDRO CHAMBER

This procedure pressurizes the Hydro Block/Hydro Chamber to locate a potential external water leak. A clamp and the **274 Ω** resistor plug from the two-resistor OLC set, is required.



a) Referring to the Figure (right), at the top of the Hydro Block/Hydro Chamber, tie wrap the segment of vent tubing that is attached to the float.

b) Referring to the Figure (below, right), place the **274 Ω** plug, from the two-resistor OLC set, into the float's distribution position labeled "FLOAT-SW" (**3rd connector cap from the left**). This simulates a closed float switch and opens incoming water valve #41.



c) If the **274 Ω** plug is placed correctly vent tubing overflow will occur within 30 seconds.

d) **Clamp** the vent tubing. This pressurizes the Block/Chamber to approximately 20 psi (per incoming water regulator #61).

e) Check at the bottom and top of the Block/Chamber. Water leak located?

Yes See procedure number DAIR- 7.0.0 (page 214).

No a) Return the float to distribution board position "FLOAT-SW" and unclamp the vent tubing.

b) Two possibilities: 1) Bad restrictor o-rings (P/N 579070, **Hydro Block ONLY**); 2) Bad deaeration motor (**Hydro Block** and **Hydro Chamber**).

DAIR- 7.0.0 TROUBLESHOOT LEAKING HYDROBLOCK / HYDROCHAMBER

a) Return the float to distribution board position "FLOAT-SW" and unclamp the vent tubing.

b) Proceed accordingly:

- **Leaking from the BOTTOM (at or from valve #39):** Three possibilities: 1) Tighten valve #29's bracket; 2) Possible bad seal o-ring under valve #39; 3) Possible cracked valve #39 body.
- **OLD STYLE HYDRO BLOCK and the leak is from between the cap and Hydro Block:** Three possibilities: 1) Bad Hydro Block seal, P/N 565642 (Type 1 block) or P/N 676270 (Type 2 block); 2) Attempt installing the Hydro Block 'brace' (P/N M31138); 3) Bad Hydro Block
- **NEW STYLE HYDRO CHAMBER:** Replace the chamber.

SECTION 14 - UF (ULTRAFILTRATION) PUMP PROBLEMS

A) If (and ONLY if) the UF pump is 'clicking' loudly check that the 'wear button' is installed correctly (see Figure 88, page 217).

B) If (and ONLY if) the "UF PUMP ALARM" message presents itself at any time place the machine into Rinse program and proceed directly to UF- 5.0.0 (page 218).

C) See procedure number UF- 1.0.0 (page 215).

UF- 1.0.0 CHECK UF PUMP CIRCUIT FOR LEAKS

a) Place the machine into Rinse program. Referring to Figure 85 (page 215). Two checks:

1. Check for external water leaks from the UF pump and UF filter #74's (white) housing.

2. Check for leaks at check valves #63 (yellow insert) and #64 (orange insert). If tubing 'blows off' one or both check valves may be oriented incorrectly.

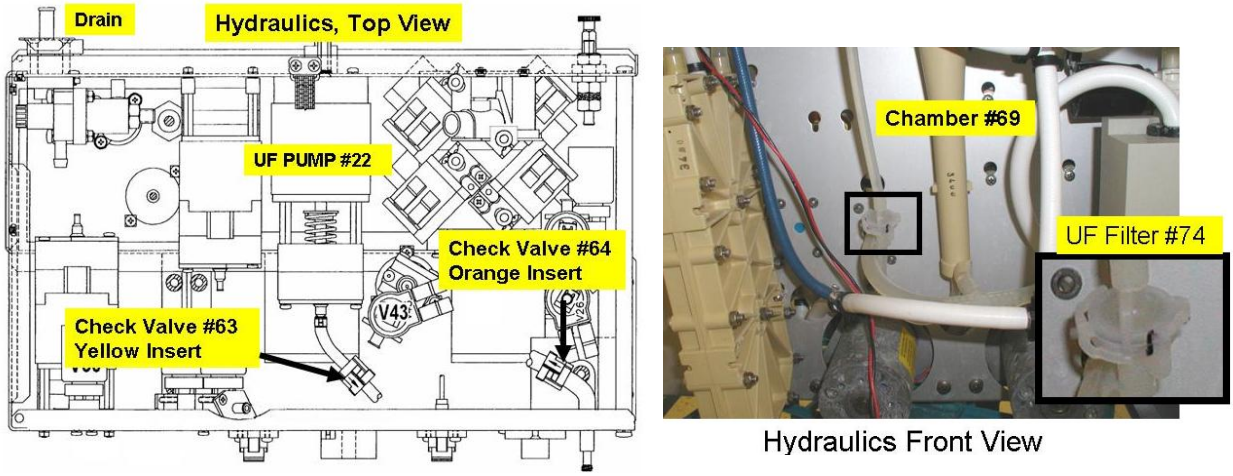


Figure 85 – UF Checks

b) Referring to Figure 86 (page 215), remove the **Fluid Sample Connector** from its port. Flow from the **Male Fluid Sample Port** indicates check valve #64 (orange insert) is bad.

c) Are there strong individual 'pulses' through the Fluid Sample Connector?

Yes See procedure number UF- 2.0.0 (page 216).

No See procedure number UF- 3.0.0 (page 216).

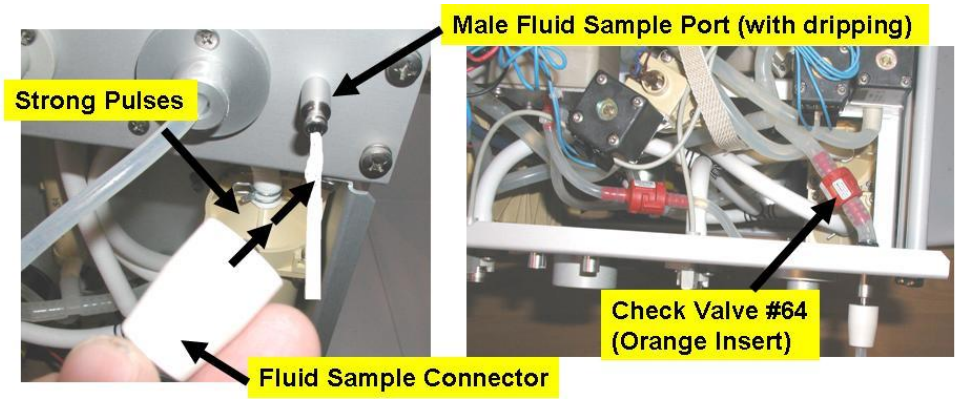


Figure 86 – UF Fluid Sample / Check Valve #64

UF- 2.0.0 CHECK UF PUMP OUTPUT CONSISTENCY

a) Enter Service Mode → Calibrate Hydraulics → UF Pump Volume

b) Attach the Fluid Sample connector to a burette accurately prefilled with 1 ml

c) Follow the screen's instructions through step #4. The [Target] data box defaults to 24 strokes. Press the blinking 'Prime' key to start UF pump stroking.

d) When the pump stops, is burette volume = 25 ml +/- 0.1 ml (1 ml +/- 0.042 ml per pump stroke)?

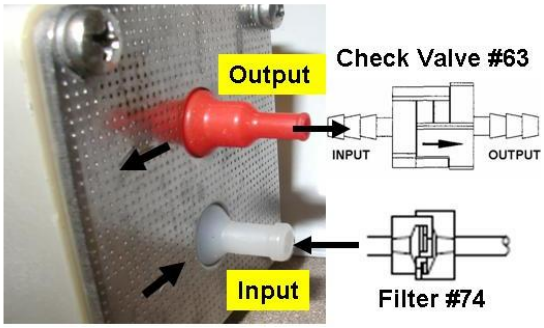
Yes Perform Alarms and Pressure Holding Tests per Preventative Maintenance Procedures. **Be sure to perform the UF Pump Integrity Test**.

No Reconnect the Fluid Sample Connector then see procedure number UF- 3.0.0 (page 216).

UF- 3.0.0 CHECK UF PUMP (#22) MECHANICS (1)

a) Referring to the Figure right ASSURE (three checks):

1. The output (colored) nozzle is on top (prevents air locks).
2. The output (colored) nozzle is mated to the mounting plate's 'output' (→) arrow.
3. The output tubing is plumbed to check valve #63 (red body, yellow insert).



b) Clamp the tubing between UF filter #74 and chamber #69 and check the internal filter segment. If a restriction is located this is the problem!

c) Reattach the tubing and **REMOVE** the clamp! **CAUTION! ASSURE the filter housing does not leak!**

d) If all above checks were okay, see procedure number UF- 3.0.1 (page 216).

UF- 3.0.1 'HEAVY SPRING' COMPRESSIONS (NO UF OUTPUT)

Referring to Figure 87 (page 216), how to proceed depends on if the machine is equipped with the **old style** or **new style** UF pump:

- **Old Style:** The 'heavy' spring can be seen from the top of the pump. See procedure number UF- 3.0.2 (page 217).
- **New Style:** The 'heavy' spring is encased and cannot be seen. See procedure number UF- 3.0.3. (page 217).

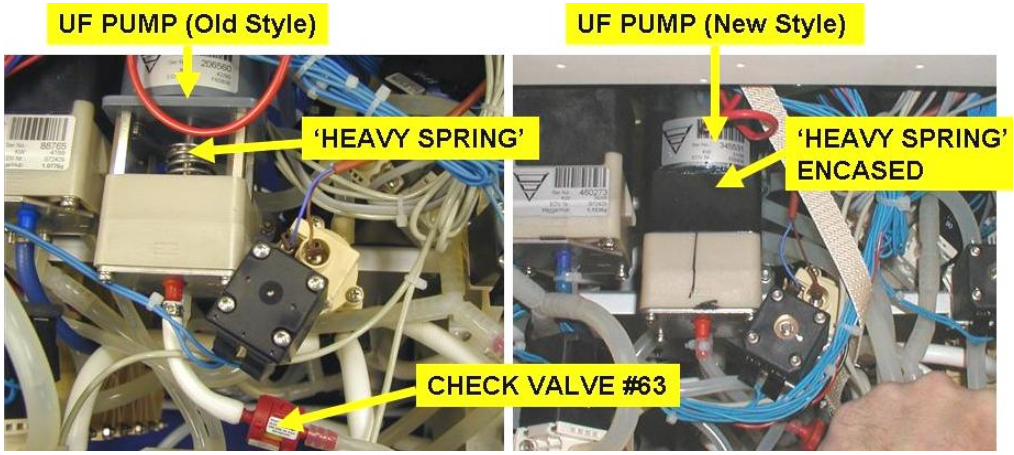


Figure 87 – UF Pump's Heavy Spring

UF- 3.0.2 OLD STYLE UF PUMP CHECK

Place the machine into Rinse program. Is the 'heavy spring' compressing and releasing?

Yes See procedure number UF- 4.0.0 (page 217).

No See procedure number UF- 5.0.0 (page 218).

UF- 3.0.3 NEW STYLE UF PUMP CHECK

a) If the machine is in Rinse pull the red concentrate connector from its rinse port to interrupt Rinse.

b) Leaving the UF pump plugged into the distribution board and its tubing attached un-mount it from the hydraulics.

c) Referring to the Figure (right), turn the pump 180° so the 'heavy spring' can be seen through the opening on the bottom.

d) IMPORTANT! Place the machine into Rinse program. Is the 'heavy spring' compressing and releasing?

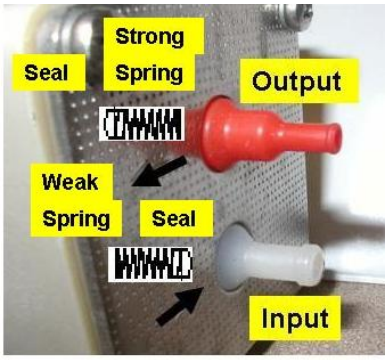
Yes See procedure number UF- 4.0.0 (page 217).

No See procedure number UF- 5.0.0 (page 218).

UF- 4.0.0 CHECK UF PUMP (#22) MECHANICS (3)

a) Turn the machine off. Referring to Figure 88 (page 217), disassemble the UF pump (four checks): **NOTE:** Do NOT misplace the **small** 'shim washers'.

1. Check for damaged (bent) OR disoriented 'weak' and 'strong' springs and/or bad seals.
2. Assure a **strong spring** is at the **output (colored) nozzle**; a **weak spring** at **input (white) nozzle**.
3. Assure the retaining clip is placed in the slot so the 'heavy' spring is at maximum compression.
4. Check the diaphragm piston, solenoid port and 'heavy' spring. Replace the UF pump if corrosion or rust is located.



b) Attempt UF PUMP Calibration per Procedure. If the pump will not calibrate possibly the number of factory installed 'shim washers' are incorrect or the UF pump is bad.

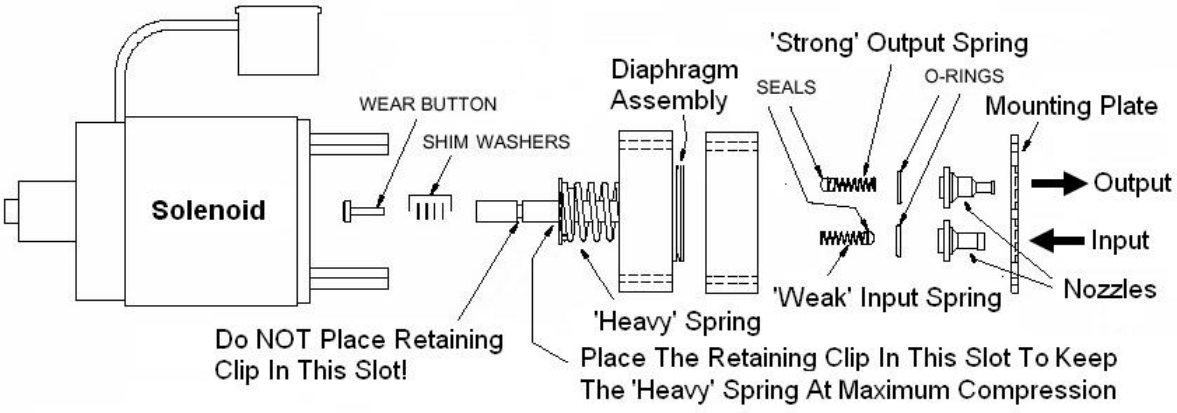
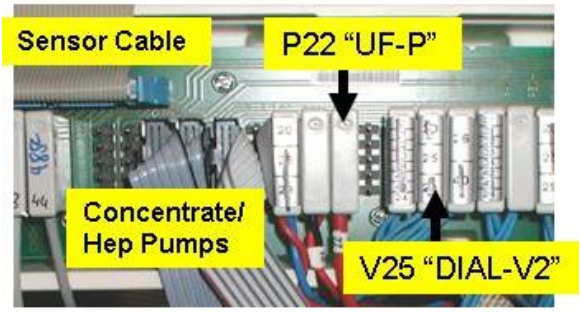


Figure 88 – UF Pump Exploded

UF- 5.0.0 CHECK UF PUMP



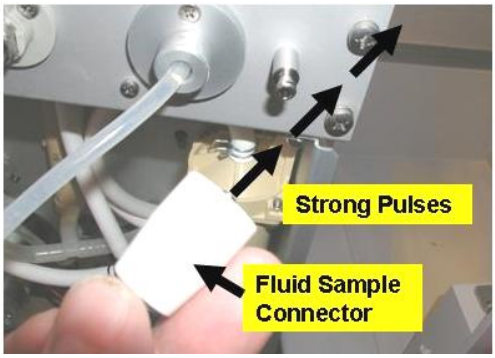
a) Referring to the Figure (right), assure the UF pump is plugged into position P22, "UF-P" and the connector is aligned properly.

b) Trace the UF pump's wiring harness from the distribution board to the pump to assure proper connections AND that the harness is not damaged OR pinched against the hydraulic cabinet.

c) Unplug the UF pump from the distribution board.

d) Using a flashlight, check **inside** the vacant "UF-P" position for 'white' corrosion or damaged **male** pins. There should be five pins.

e) Assuring the Rinse program's "Remaining Time" has not reached 0:00 CAREFULLY plug the UF pump's connector into valve #25's distribution board position (V25, "DIAL-V2", see Figure above). **CAUTION! Avoid the empty connector to the left of V25!**



f) Referring to the Figure (right) remove the Fluid Sample Connector and watch for strong UF pulses for one minute (if necessary). Are there EVER strong pulses?

Yes Three possibilities: 1) Bad Actuator Board; 2) Bad actuator cable*; 3) Bad distribution board.

No Replace the UF pump.

* The cable can be checked for continuity. **NOTE** that four (4) **UF PUMP** connections will be checked and proceed to page 225, SECTION 16 - CHECKING THE ACTUATOR BOARD CABLE.

SECTION 15 - BLOOD LEAK PROBLEMS

The blood leak detector can detect blood as little as 0.35 ml/Liter! If a patient is on the machine, before considering service, check for a 'real' blood leak using a Hemastix® strip or equivalent per unit procedure.

BL- 1.0.0 CHECK FOR FLOW ERROR

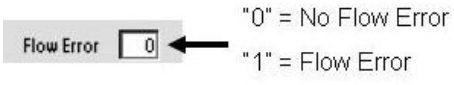
a) Place the dialyzer quick connectors into the shunt and the close the door.

b) Place a venous 'dummy chamber' in the Level Detector.

c) RESET an Air Detector alarm i.e. the red alarm LED (see Figure right) OFF.

d) **IMPORTANT!** If Automated Tests start (screen reads "Test …") at ANY time allow them to complete! Automated Testing, while troubleshooting, may cause misdiagnosis! IGNORE all test fail messages for now!

e) Call debug screen 0. CAREFULLY watch Flow Error for two minutes or until if **Flow Error** = 1. Proceed accordingly:



- **Flow Error = 1 (constant or intermittent):** Proceed to **page 14**, SECTION 1 - FLOW ERRORS IN DIALYSIS PROGRAM.
- **Flow Error = 0 (constant):** See procedure number BL- 1.0.2 (page 219).

BL- 1.0.2 CHECK TEMPERATURE / CONDUCTIVITY

a) ASSURE the machine has been running in Dialysis program, with Dialysate flow on (Dialysate Flow on/off LED off), connected to fresh concentrate, for at least five minutes.

b) Call the Home screen. Watch both Temperature and Conductivity for one minute: Two checks:

1) If (and ONLY if) Temperature is NOT between 35.1 and 38.9° C AND remaining stable (+/- 0.15° C) proceed to page 92, SECTION 4 – TEMPERATURE PROBLEMS.

2) If (and ONLY if) Conductivity is NOT between 13.0 and 14.5 AND remaining stable (+/- 0.2 mS) proceed to page 128, SECTION 5 – CONDUCTIVITY PROBLEMS.

c) **IMPORTANT!** Set Dialysate flow to 500 ml/min (NOT "a500") press the 'CONFIRM' key.

d) **IMPORTANT!** Unless instructed, do NOT reset alarms!

e) **IMPORTANT!** ASSURING the Bypass LED (front panel) remains **OFF** is the external flow indicator's 'bob' is rising (at least ¼ way up) and falling?

Yes See procedure number BL- 1.0.3 (page 220).

No a) If (and ONLY if) Dialysate Flow is NOT set to 500 ml/min return to BL- 1.0.2 (page 219), part c.

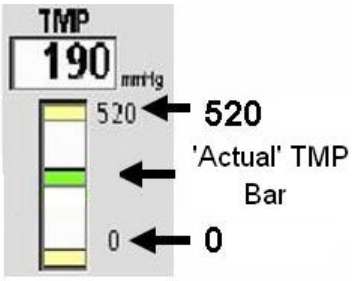
b) Proceed to **page 14**, SECTION 1- FLOW ERRORS IN DIALYSIS PROGRAM.

BL- 1.0.3 CHECK TMP

a) Referring to the Figure (right), the TMP bar graph is populated with two yellow alarm Limits (positioned at 520 and 0) and an 'actual' TMP **bar** which is either red (with a TMP alarm) or green (no TMP alarm).

b) Press and release the 'RESET' key then immediately press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. **Ignore temporary Flow Errors during reset!** If a TMP alarm occurs repeat the RESET sequence once more then continue.

c) Watch for 45 seconds. Does the 'actual' TMP bar remain green?



Yes See procedure number BL- 1.0.4 (page 220).

No Proceed to **page 177**, SECTION 9- TMP PROBLEMS.

BL- 1.0.4 RESET BLOOD LEAK ALARM

Is the Blood Leak alarm still present?

Yes Press and release the 'RESET' key three times in 20 second intervals. Proceed accordingly:

- **Blood Leak alarm clears:** See procedure number BL- 1.0.5 (page 220).
- **Blood Leak alarm does NOT clear:** See procedure number BL- 2.0.0 (page 221).

No See procedure number BL- 1.0.5 (page 220)

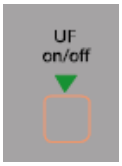
BL- 1.0.5 BLOOD LEAK ALARM NOT PRESENT (CHECK FOR AIR)

a) Referring to Figure 89 (page 220), and using a flashlight check the external acid and bicarbonate concentrate inlet lines for air. If air bubbles are seen repair the leaking concentrate connector

b) Clear ALL alarms and turn the blood pump on to 200 ml/min or greater.

c) From the Home screen, set UF Goal to 3000 ml/Hr. Set UF Rate to 750 ml/hr.

d) Press the UF on/off key (front panel) to turn the UF pump on (UF on/off LED on).



e) Allow TMP to increase to about 160 mmHg then turn UF off (UF on/off LED off). TMP should be rise to between 180 and 260 mmHg. **NOTE:** If (and ONLY if) the machine goes into Filling Program an air leak may be present. In this event (ONLY) see procedure number BL- 3.0.0 (page 221).

f) Referring to Figure 89 (page 220), using a flashlight check through the tubing from the Blood Leak Sensor #8. Is air seen?

Yes See procedure number BL- 3.0.0 (page 221).

No See procedure number BL- 6.0.0 (page 224).

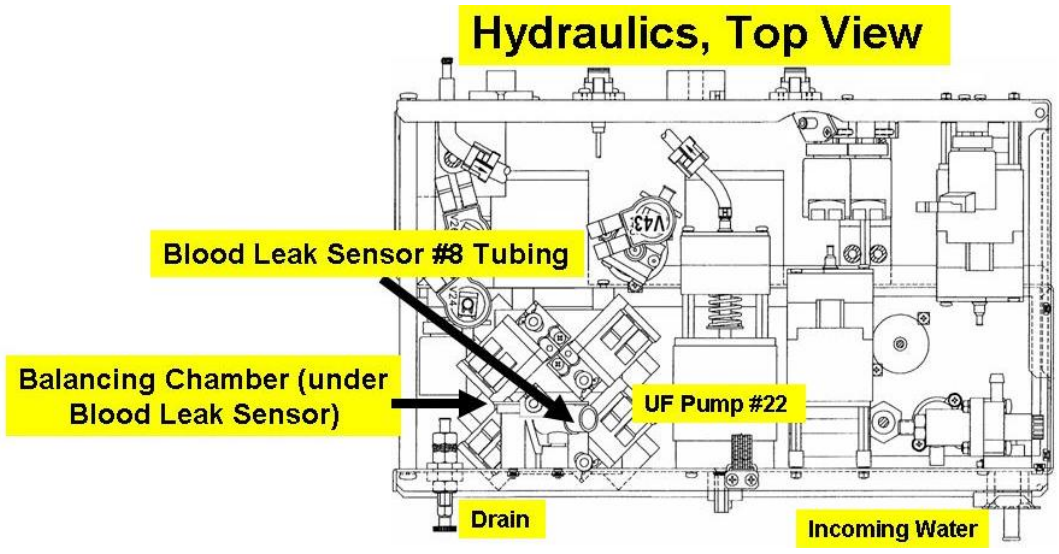


Figure 89 – Hydraulics (Top View) / Blood Leak Sensor

BL- 2.0.0 BLOOD LEAK ALARM PRESENT (CHECK FOR AIR)

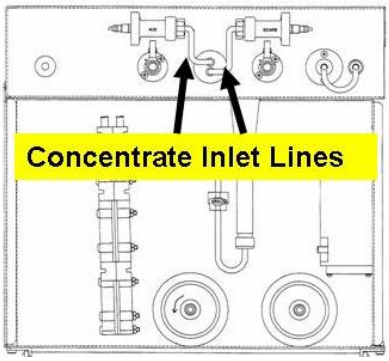
Referring to Figure 89 (page 220), using a flashlight, check through the tubing from the Blood Leak Sensor #8. Is air seen?

Yes See procedure number BL- 3.0.0 (page 221).

No See procedure number BL- 4.0.0 (page 222).

BL- 3.0.0 CHECK FOR AIR

Referring to the Figure (right), using a flashlight, check through the clear concentrate inlet lines. Are there excessive air bubbles seen?



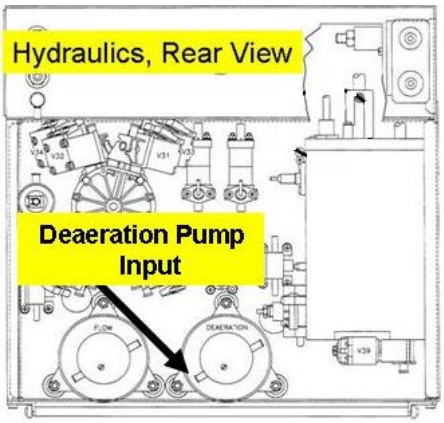
Yes Three checks: **1)** Wand(s) (if using jugs); **2)** Red and/or blue concentrate connector(s); **3)** Connection to the concentrate source(s).

No See procedure number BL- 3.0.1 (page 221).

BL- 3.0.1 CHECK AIR REMOVAL SYSTEM

a) Turn Dialysate flow off (Dialysate flow on/off LED blinks) and allow one minute for the deaeration pump to stop.

b) Referring to the Figure (right), tee a gauge to the INPUT (clear tubing) of the deaeration pump.



c) **IMPORTANT!** Turn Dialysate flow ON (Dialysate Flow on/off LED off).

d) Referring to Appendix A (page 260), is Deaeration pressure okay?

Yes See procedure number BL- 3.0.4 (page 221).

No See procedure number BL- 3.0.2 (page 221)

BL- 3.0.2 CALIBRATE DEAERATION PRESSURE

Calibrate DEAERATION AND LOADING PRESSURE per procedure. Is the calibration successful?

Yes See procedure number BL- 3.0.3 (page 221).

No Proceed to **page 211**, SECTION 13 - DEAERATION PROBLEMS.

BL- 3.0.3 LOCATE AIR LEAK

a) Place the machine into Dialysis Program (remember to press the 'CONFIRM' key).

b) Allow Temperature and Conductivity to become normal.

c) Check for air again at the blood leak sensor (see Figure 89, page 220). If (and ONLY if) air is seen see procedure number BL- 3.0.4 (page 221). If (and ONLY if) air is NOT seen AND the Blood Leak alarm will not RESET continue see BL- 4.0.0 (page 222).

BL- 3.0.4 LOCATE AIR LEAK

a) **NOTE** this procedure and page number in case you need to return here.

b) Proceed to page 208 and perform SECTION 12 - INDUCED POSITIVE PRESSURE TESTS. If a water leak is not located continue with part c.

c) Perform SECTION 11 - INDUCED AIR LEAK TESTS (page 202).

IMPORTANT! Do NOT troubleshoot Blood Leak Problems if leaks are present!

BL- 4.0.0 CHECK BLOOD LEAK DETECTOR #8

a) **IMPORTANT!** If Automated Tests start (screen reads "Test …") allow them to complete! Automated Testing, while troubleshooting, may cause misdiagnosis! IGNORE all test fail messages for now!

b) Remove the venous 'dummy chamber' from the Level Detector module to prevent 'Forced Test'.

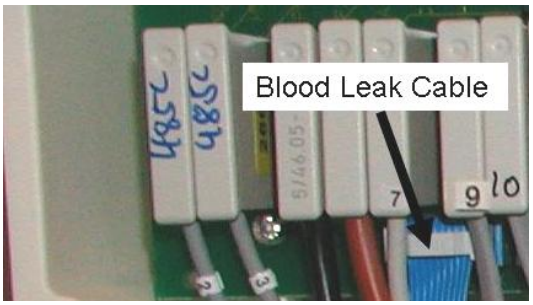
c) Call debug screen 4 to watch **LEAK** and **DIMN**. Proceed as instructed below (six scenarios):

1. **LEAK remaining between 4.5 and 5.2 AND DIMN remaining between 4 and 6:** Both blood leak channels are displaying NO blood leak. Bleach Disinfect the machine and if the Blood Leak returns in the near future see procedure number BL- 6.0.0 (page 224).
2. **LEAK less than 0.2 volts:** See procedure number BL- 4.0.1 (page 222).
3. **DIMN less than 0.2 volts:** See procedure number BL- 4.0.1 (page 222).
4. **LEAK greater than 5.2 volts:** See procedure number BL- 4.0.2 (page 222).
5. **DIMN greater than 6.0 volts:** See procedure number BL- 4.0.2 (page 222).
6. **All others:** See procedure number BL- 6.0.0 (page 224).

BL- 4.0.1 CHECK FOR 'OPEN' BLOOD LEAK DETECTOR

a) **IMPORTANT!** To prevent damage, turn the machine off!

b) Referring to the Figure (right), ASSURE the small (blue) Blood Leak Cable is plugged securely into the distribution board. **If not this may be the problem!**



c) **NOTE** this procedure and page number in case you need to return here.

d) The sensor cable MAY be bad. **NOTE** that five (5) BLOOD LEAK connections will be checked and proceed to page 228, SECTION 17 - CHECKING THE SENSOR BOARD CABLE.

e) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

f) Allow eight minutes or until the Bypass LED turns off then see procedure number BL- 5.0.0 (page 223).

BL- 4.0.2 CHECK FOR 'SHORTED' BLOOD LEAK DETECTOR

a) **IMPORTANT!** Turn the machine off.

b) Referring to the Figure (above, right) unplug the small (blue) Blood Leak Cable from the distribution board.

c) Using a flashlight, check the **inside** the vacant distribution board position for 'white' corrosion or damaged **male** pins that may cause false signals from the distribution board.

d) If the distribution board is okay, and leaving the cable unplugged for now, place the machine into Dialysis Program (remember to press the 'CONFIRM' key)

e) Call debug screen 4. Is **LEAK** and **DIMN** = 0 volts?

Yes a) Turn the machine off and return the blood leak cable to the distribution board.

b) Place the machine into Dialysis program (remember press the 'CONFIRM' key).

c) Allow eight minutes for stabilization then see procedure number BL- 5.0.0 (page 223).

No Three possibilities: 1) Bad sensor cable; 2) Bad sensor board (see Figure 4A, page 8); 3) Bad distribution board.

BL- 5.0.0 CHECK BLOOD LEAK

CAUTION! During this procedure DC voltages will be measured at pins that are close together and 'shorting' them with a regular meter probe may damage the VERY EXPENSIVE sensor board. It is HIGHLY RECOMMENDED the Fluke TP 80 meter probe (or equivalent), together with the protective cap (see Figure 5, page 11) is used! If a Fluke TP 80 (or equivalent) is not available see BL- 6.0.0 (page 224).

a) Open the card cage. Place the meter's ground (black) lead on chassis ground (see Figure 1, page 3).

b) Call debug screen 4 to see **LEAK** and **DIMN**.

c) Referring to Figure 90 (page 223) and Table 25 (page 223), **using the Fluke TP 80**, CAREFULLY measure DC voltages from the solder (rear) side of the sensor board's X2 connector:

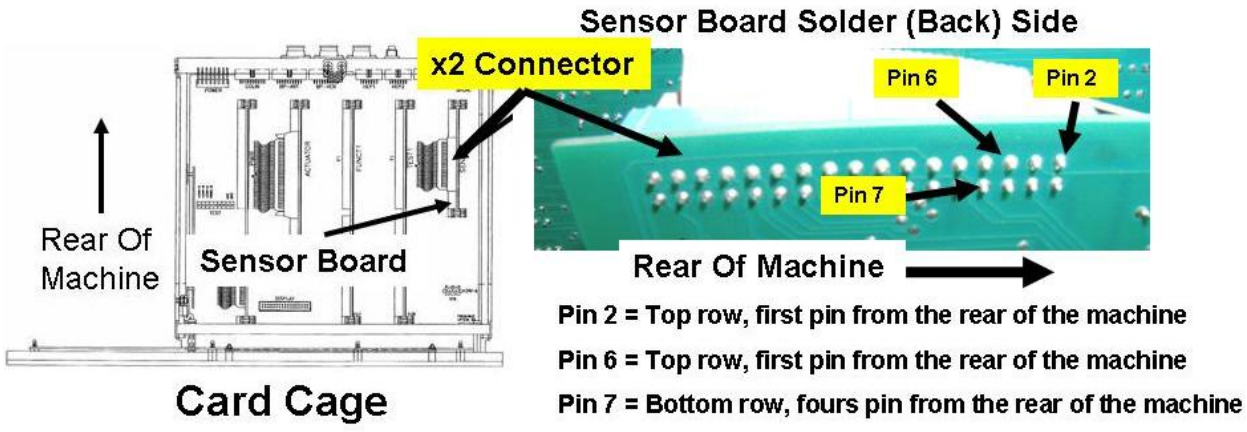

Sensor Board Solder (Back) Side
x2 Connector
Pin 6
Pin 2
Pin 7
Rear Of Machine
Rear Of Machine
Sensor Board
Card Cage
Pin 2 = Top row, first pin from the rear of the machine
Pin 6 = Top row, first pin from the rear of the machine
Pin 7 = Bottom row, fours pin from the rear of the machine

Figure 90 – Electronic Card Cage (Sensor Board)

Table 25 – Sensor Board 'X2' DC Voltage Checks (Refer to Figure 90)

X2 Pin	X2 Pin Location	Response:
2	Top row, first pin from the rear of the machine	• **Less than 0.5 volts DC:** Measure at pin 6 (next row in this table) • **Greater than 0.5 volts DC:** Bad test board (see page 8).
6	Top row, third pin from the rear of the machine	• **Less than 4.5 volts DC:** See procedure number BL- 6.0.0 (page 224). • **Greater than 5.2 volts DC:** See procedure number BL- 6.0.0 (page 224). • **Between 4.5 and 5.2 volts DC:** Does debug screen 4, **LEAK** = pin 6 +/- 0.3? Yes Measure at pin 7 (next row in this table). No Bad sensor board (see page 8).
7	Bottom row, fourth pin from the rear of the machine	• **Less than 4.0 volts DC:** See procedure number BL- 6.0.0 (page 224). • **Greater than 6.0 volts DC:** See procedure number BL- 6.0.0 (page 224). • **Between 4.0 and 6.0 volts DC:** Does debug screen 4, **DIMN** = pin 7 +/- 0.3? Yes See procedure number BL- 6.0.0 (page 224). No Bad sensor board (see page 8).

BL- 6.0.0 CLEAN / CALIBRATE BLOOD LEAK SENSOR #8

a) **IMPORTANT!** Perform ACID CLEAN followed by BLEACH DISINFECT to assure the Blood Leak Detector's glass cuvette is clean. **WARNING!** Attempting a Blood Leak calibration without first performing Acid Clean and Bleach Disinfect may lead to unnecessary work and/or cause inaccurate calibration of the Blood Leak Sensor!

b) Place the machine into Service mode → Calibrate Sensors → Blood Leak Detector.

c) Press the 'CONFIRM' key to begin then read on. Normally the automated calibration, one at a time, takes the screen's **Leak** AND **Dimness** data windows to approximately 5.00 and they should stabilize fairly quickly. This indicates a successful calibration causing the screen to advance to step #5 "Calibration complete, press the [CONFIRM] key to save". If one OR the other data window does NOT stabilize within three minutes there is a problem!

d) Is the Blood Leak calibration successful?

Yes — Press the 'CONFIRM' key twice to save the calibration. Problem solved (at least for now). If a false Blood Leak alarm reoccurs in the near future, six intermittent possibilities: **1)** Bad Blood Leak Sensor #8 (see Figure 89, page 220); **2)** Bad actuator board; **3)** Bad sensor board; **4)** Bad sensor cable; **5)** Bad function board; **6)** Bad distribution board. **NOTE: See Figure 4A (page 8) to locate all listed circuit boards**.

No — Turn the machine off and swap the following seven components, one at time, with known good, attempting Blood Leak calibration in between: **1)** Actuator board; **2)** Test board; **3)** Blood Leak Detector #8 (see Figure 89, page 220); **4)** Sensor cable; **5)** Sensor board; **6)** Function board; **7)** Distribution board. **NOTE: See Figure 4A (page 8) to locate all listed circuit boards**.

SECTION 16 - CHECKING THE ACTUATOR BOARD CABLE

This procedure checks the actuator cable by measuring resistance (Ω) between the distribution and actuator board. A good cable will measure two (2) **Ω** or less. **CHECK ONLY the NOTED component!**

a) **IMPORTANT!** To prevent damage, turn the machine off!

b) Referring to Figure 3 (page 5), unplug the cable from the distribution board's ACTUATOR connector. CAREFULLY check inside the vacant connector for 'white' corrosion or damaged **male** pins.

c) CAREFULLY check the **female** connector and the entire length of the cable for damage.

d) Referring to Figure 91 (page 225), the **female** connector has two rows of plugs. Hold the connector with its **KEY TAB** towards the floor. In this position, even numbered plugs are in the top row, odd numbered in the bottom. NOTE the reference to the 'rear of the machine'.

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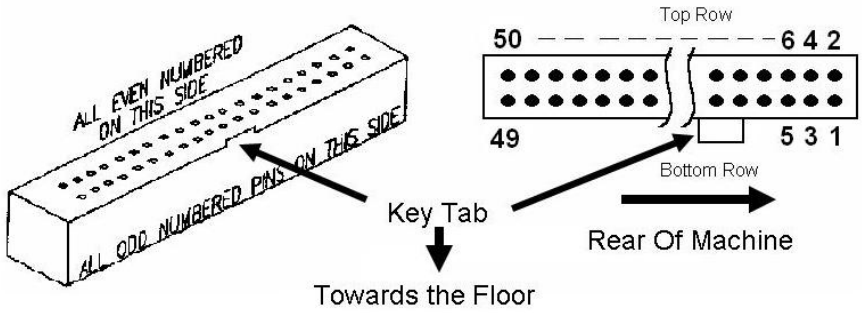

Figure 91 – Female Actuator Board Connector

e) A regular meter probe may NOT penetrate the female connector deep enough to make a good connection and a **paper clip may damage the connector**! Use an 18 - 22 gauge non-stranded wire as a 'probe'.

f) Referring to Table 26 (page 226), to check a NOTED PUMP OR Table 27 (page 227), to check a NOTED VALVE, determine the appropriate numbered plug(s). Referring to the Figure (right), insert the 'wire probe', then place (or clip) one of the ohm meter leads onto it.

g) Open the card cage. Referring to Figure 92 (page 225), the cable terminates at the actuator board's P2 connector. The solder (rear) side pins are in two rows. Odd numbered in the bottom row, even numbered in the top. NOTE the reference to the 'rear of the machine' to locate the appropriate pin per Table 26 OR Table 27.

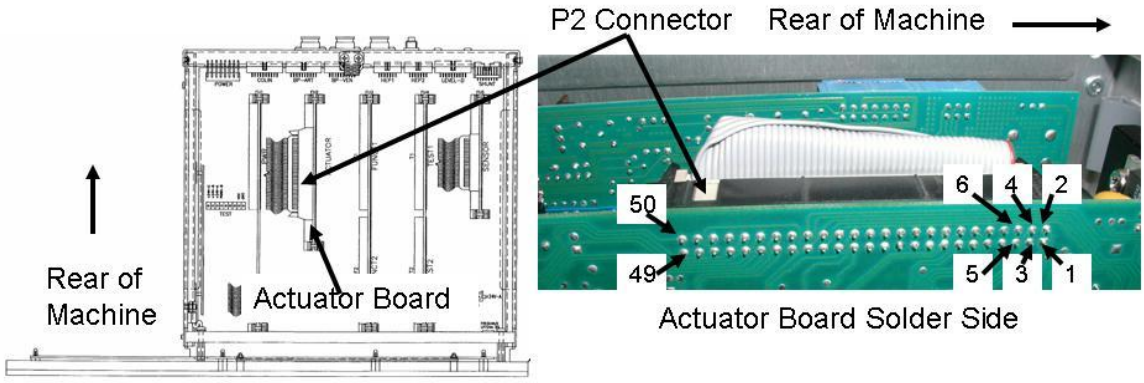

Figure 92 – Electronic Card Cage (Actuator Board)

h) Touch the ohm meter leads together and subtract this resistance (Ω) reading from subsequent resistance readings.

i) Using a **regular** meter lead (**do NOT use Fluke TP 80**), place it on the matching numbered pin (per Table 26 or Table 27) on the solder (back) side of the P2 connector. **IMPORTANT! Some components may have more than one pin to check**.

j) Is the meter's numeric AND units display 2 **Ω** or less?

Yes The cable is good! Return it the distribution board. If referred to CHECKING THE ACTUATOR BOARD CABLE, return to the procedure that brought you here.

No Unplug the cable from the actuator board's P2 connector. Check inside the connector for bent, missing or damaged **male** pins. If the pins are okay replace the cable.

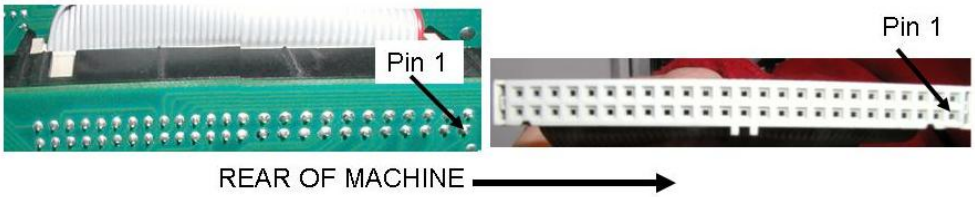

Table 26 – Actuator Board, P2 Cable. Pin Identification (for Pumps)

PUMP	PLUG/PIN #	P2 / FEMALE CONNECTOR LOCATION
DEAERATION PUMP (1 of 2)	15	Bottom row, 8 pins from the rear of machine
DEAERATION PUMP (2 of 2)	16	Top row, 8 pins from the rear of machine
FLOW PUMP (1 of 2)	19	Bottom row, 10 pins from the rear of machine
FLOW PUMP (2 of 2)	20	Top row, 10 pins from the rear of machine
ACID PUMP (1 of 4)	1	Bottom row, first pin from the rear of machine
ACID PUMP (2 of 4)	2	Top row, first pin from the rear of machine
ACID PUMP (3 of 4)	3	Bottom row, 2 pins from the rear of machine
ACID PUMP (4 of 4)	4	Top row, 2 pins from the rear of machine
BICARB PUMP (1 of 4)	5	Bottom row, 3 pins from the rear of machine
BICARB PUMP (2 of 4)	6	Top row, 3 pins from the rear of machine
BICARB PUMP (3 of 4)	7	Bottom row, 4 pins from the rear of machine
BICARB PUMP (4 of 4)	8	Top row, 4 pins from the rear of machine
UF PUMP (1 of 4)	23	Bottom row, 12 pins from the rear of machine
UF PUMP (2 of 4)	24	Top row, 12 pins from the rear of machine
UF PUMP (3 of 4)	25	Bottom row, 13 pins from the rear of machine
UF PUMP (4 of 4)	26	Top row, 13 pins from the rear of machine

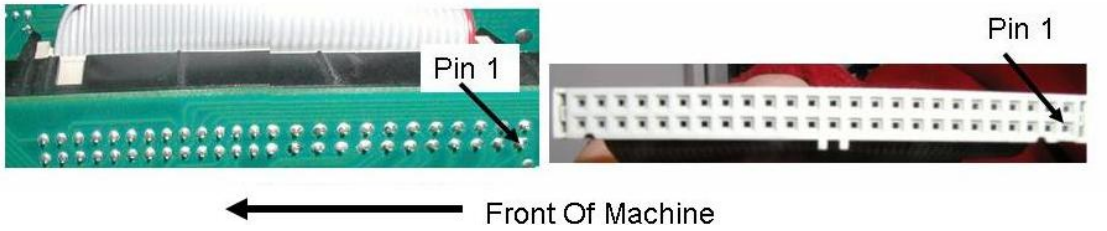

Table 27 – Actuator Board, P2 Cable, Pin Identification (for Valves)

VALVE#	PLUG/PIN #	P2/ FEMALE CONNECTOR LOCATION
41 (27)	32	Top row, 10 pins from the front of the machine
24	29	Bottom row, 11 pins from the front of the machine
25	30	Top row, 11 pins from the front of the machine
26	31	Bottom row, 10 pins from the front of the machine
29	34	Top row, 9 pins from the front of machine
30	35	Bottom row, 8 pins from the front of the machine
31	36	Top row, 8 pins from the front of the machine
32	37	Bottom row, 7 pins from the front of the machine
33	38	Top row, 7 pins from the front of the machine
34	39	Bottom row, 6 pins from the front of the machine
35	40	Top row, 6 pins from the front of the machine
36	41	Bottom row, 5 pins from the front of the machine
37	42	Top row, 5 pins from the front of the machine
38	43	Bottom row, 4 pins from the front of the machine
39	44	Top row, 4 pins from the front machine
43	46	Top row, 3 pins from the front of machine

SECTION 17 - CHECKING THE SENSOR BOARD CABLE

This procedure checks the cable by measuring resistance (Ω) between the distribution and sensor board. A good cable will measure two (2) **Ω** or less. **Check ONLY the NOTED component!**

a) **IMPORTANT!** To prevent damage, turn the machine off!

b) Referring to Figure 3 (page 5), unplug the cable from the distribution board's SENSORS connector. Check inside the vacant connector for 'white' corrosion or damaged **male** pins.

c) CAREFULLY check the **female** connector and the entire length of the cable for damage.

d) Referring to Figure 93 (page 228), the **female** connector has two rows of plugs. Hold the connector with its **KEY TAB** towards the floor. In this position, even numbered plugs are in the top row, odd numbered in the bottom. NOTE the reference to the 'rear of the machine'.

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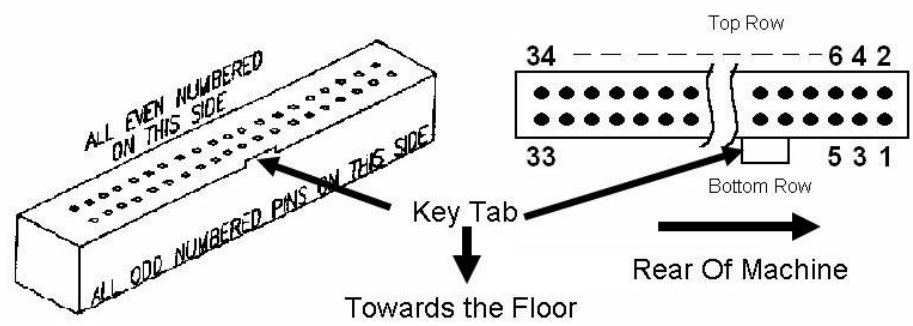
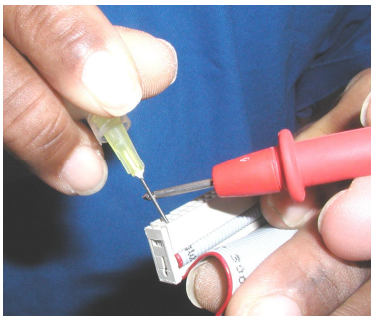


Figure 93 – Female Sensor Cable Connector



e) A regular meter probe may NOT penetrate the female connector deep enough to make a good connection and a **paper clip may damage the connector**! Use an 18 - 22 gauge non-stranded wire as a 'probe'

f) Referring to Table 28 (page 229), determine the plug number(s) for the NOTED component and insert the 'wire probe'. Referring to the Figure (right), place (or clip) one of the meter leads onto the 'wire probe'.

g) Open the card cage. Referring to Figure 94 (page 228), the cable terminates at the sensor board's X2 connector. The solder (rear) side pins are in two rows. Odd numbered in the bottom row, even numbered in the top. NOTE the reference to the 'rear of the machine' to locate the appropriate pin number per Table 28.

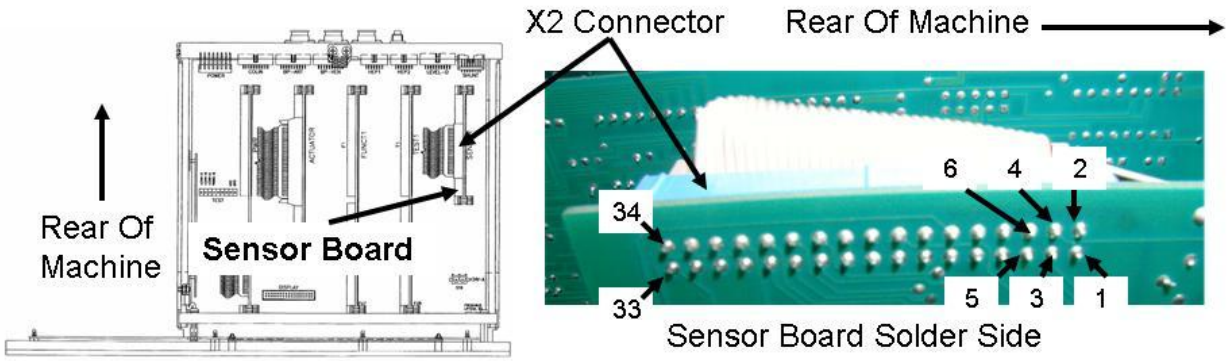


Figure 94 – Electronic Card Cage (Sensor Board)

h) Touch your ohm meter leads together and subtract this resistance (Ω) reading from subsequent resistance readings.

i) Using a **regular** meter probe (**do NOT Fluke TP 80**), place it on the matching numbered pin (per Table 29) on the solder (back) side of the X2 connector. **IMPORTANT! Some components may have more than one pin to check!**

j) Is the meter's numeric AND units display 2 **Ω** or less?

Yes The cable is good! Return it to the distribution board. If referred to CHECKING THE SENSOR BOARD CABLE, return to the procedure that brought you here.

No Unplug the cable from the sensor board's X2 connector. Check inside the connector for bent, missing, or damaged **male** pins. If the pins are okay replace the cable.

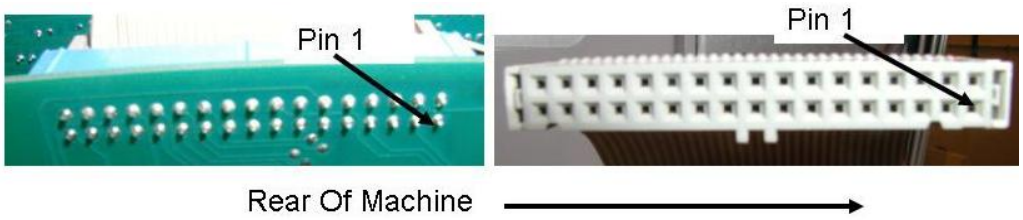


Table 28 – Sensor Board, X2 Cable, Pin Identification

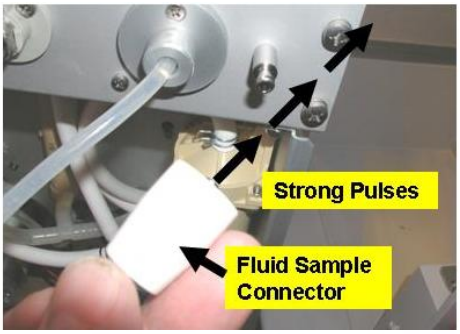
HYDRAULIC COMPONENT	PLUG/PIN #	x2 / FEMALE CONNECTOR LOCATION
NTC #3	12	Top row, 6 pins from the rear of machine
NTC #2	13	Bottom row, 7 pins from the rear of machine
FLOAT	21	Bottom row, 7 pins from the front of machine
CFS TRANSDUCER (1 of 3)	11	Bottom row, 6 pins from the rear of machine
CFS TRANSDUCER (2 of 3)	14	Top row, 7 pins from the rear of machine
CFS TRANSDUCER (3 of 3)	15	Bottom row, 8 pins from the rear of machine
COND CELL	16	Top row, 8 pins from the rear of machine
ACID EOS	25	Bottom row, 5 pins from the front of machine
BICARB EOS	23	Bottom row, 6 pins from the front of machine
AIR SENSOR	5	Bottom row, 3 pins from the rear of machine
BLOOD LEAK TEST (1 of 5)	2	Top row, first pin from the rear of machine
BLOOD LEAK CAL DIMNESS (2 of 5)	3	Bottom row, 2 pins from the rear of machine
BLOOD LEAK CAL BL (3 of 5)	4	Top row, 2 pins from the rear of machine
BLOOD LEAK OUTPUT (4 of 5)	6	Top row, 3 pins from the rear of machine
BLOOD LEAK OUTPUT (5 of 5)	7	Bottom row, 4 pins from the rear of machine
DIALYSATE TRANSDUCER (1 of 3)	8	Top row, 4 pins from the rear of machine
DIALYSATE TRANSDUCER (2 of 3)	10	Top row, 5 pins from the rear of machine
DIALYSATE TRANSDUCER (3 of 3)	11	Bottom row, 6 pins from the rear of machine

SECTION 18A - AUTOMATED VALVE LEAK TESTS

Perform these tests ONLY as directed from previous procedures. Arbitrary performance may yield erroneous results and unnecessary work!

NOTE! Valve leak failures can be due to several machine systems. Follow these procedures precisely to avoid unnecessary valve replacement!

A. INITIALIZING AUTOMATED LEAK TESTS:



a) Place the machine into Rinse program. **WARNING! Failure to Rinse may yield erroneous results!**

b) Referring to the Figure (right), remove the Fluid Sample Connector from its port. If (and ONLY if) there are NO strong pulses proceed to page 215, UF PUMP PROBLEMS.

c) Return the Fluid sample connector to its port.

d) Using a flashlight**, THOROUGHLY** check inside the hydraulic compartment and at the DiaSafe® filter (if equipped) for external water leaks. **Leaks can be very small and take a while to become obvious! If a leak is located, this is the problem!**

e) Referring to the Figure (right), assure that air sensor #6's connector is plugged into the distribution board at position labeled "AIR-SEN".

f) Place the concentrate connector(s) into concentrate. Enter Service Mode → Diagnostics → Valve Leak Test. When the [Test Status] data box = "Ready" proceed to B. PERFORM LEAK TESTS (page 230).

B. PERFORM LEAK TESTS

a) Select the [Valve Number] data box. It turns bright yellow. Use the up/down arrow keys (K machine) or +/- keys (K[2] machine) until the data box = **"IOS"**[1] OR **"Valve Number"** [2] (as directed from previous procedures) OR **"auto"**[3].

[1] **IOS** (Integrity **O**f **S**ystem) is performed with all valves closed to isolate air removal chamber #69. **If IOS fails subsequent leak test failures are invalid!** [2] **Valves** can be tested individually but ONLY after IOS has passed. [3] **auto** performs IOS and all valve leak tests.

NOTE! If a leak test fails repeat it. Two of three failures should be investigated further per the procedures below!

b) Press the 'CONFIRM' key to begin the tests(s). When complete if the [TEST STATUS] box =:

"Passed": Test all other valves as directed in previous procedures. If ALL tests pass a leak is NOT indicated. If referred to AUTOMATED VALVE LEAK TESTS return to the procedure that brought you here.

"Failed": Return to B. PERFORM LEAK TESTS (page 230) to repeat the test. If it fails **two of three** times, proceed accordingly (four scenarios):

1. **IOS has failed:** See procedure number AUTOTEST- 1.0.0 (page 231).
2. **IOS passed but valve #43 fails:** See procedure number AUTOTEST- 2.0.0 (page 232).
3. **IOS passed but valve #29 fails:** See procedure number AUTOTEST- 3.0.0 (page 233).
4. **IOS passed and other valves (besides valve #43 and #29) have failed: NOTE** the **leaking valve** then see procedure number AUTOTEST- 5.0.0 (page 234).

AUTOTEST- 1.0.0 CHECK LOADING PRESSURE

The "IOS" test requires good loading pressure:

a) **IMPORTANT!** Assure the loading pressure gauge (with yellow connector) reads 0 psi before inserting!

b) **SLAM** the yellow connector into the red Acetate/Acid rinse port.

c) Repeat the "IOS" test. During the "Prep" phase, does loading pressure reach a maximum of between 17 and 29 psi?

Yes See procedure number AUTOTEST- 1.0.1 (page 231).

No a) Return to Dialysis program (remember to press the 'CONFIRM' key).

b) Proceed to **page 18**, procedure number **F- 2.0.4**.

AUTOTEST- 1.0.1 TROUBLESHOOTING IOS FAILURE

The "IOS" test isolates the 'area' of Air Removal Chamber #69. If "IOS" fails all other leak tests are invalid!

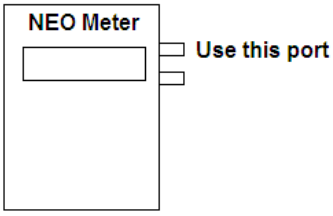
a) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

b) Allow three minutes!

c) **IMPORTANT!** Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks).

d) Referring to the Figure (below, right), place the four-way Test Assembly into the dialysate lines and hang the assembly over the dialyzer holder.

e) If using a NEO-2 meter connect to the top pressure port (see Figure right).

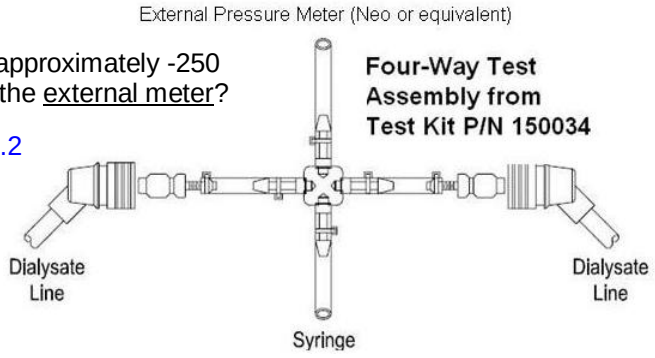


f) **IMPORTANT!** Close the shunt door.

g) Pull on the syringe plunger. Are you able to create approximately -250 mmHg **AND** HOLD it (+/- 20 mmHg per minute) on the external meter?

Yes See procedure number AUTOTEST- 1.0.2 (page 231).

No Proceed to **page 183**, procedure number TMP- 1.4.3.



AUTOTEST- 1.0.2 CHECK DIALYSATE PRESSURE

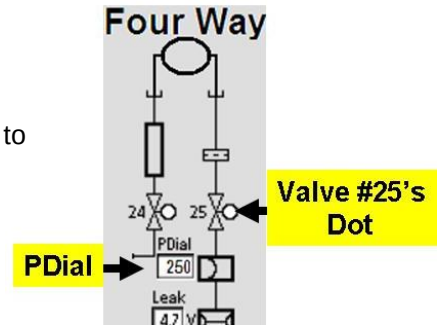
a) Clamp the syringe tubing to hold pressure at the meter.

b) Call debug screen 0. Referring to the Figure (right), if (and ONLY if) valve #25's adjacent dot is NOT blue see AUTOTEST- 1.0.3 (page 232).

c) With approximately -250 mmHg on the external meter and referring to the Figure (right), is the **PDial** window within +/- 25 of the external meter reading?

Yes Return to A. INITIALIZING AUTOMATED LEAK TESTS (page 230).

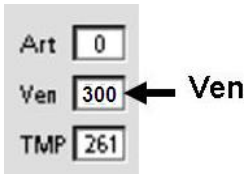
No Proceed to **page 187**, procedure number **TMP- 6.0.0**.



AUTOTEST- 1.0.3 CHECK VENOUS PRESSURE

a) Referring to the Figure (right), attach a piece of tubing, with a syringe attach a piece of tubing, with a syringe attached, to the P_{ven} port at the Level Detector module.

b) Push on the syringe plunger until **Ven** (lower right corner, see Figure right) is approximately 300 then **clamp the syringe**.



c) **IMPORTANT!** Do NOT detach the tubing so that **Ven** remains approximately 300 mmHg. Is valve #25's adjacent dot blue now?

Yes — Return to procedure number AUTOTEST- 1.0.2 (page 231), part b.

No — Return the dialysate lines to the shunt and proceed to **page 177**, SECTION 9- TMP PROBLEMS

AUTOTEST- 2.0.0 TROUBLESHOOTING A VALVE #43 LEAK

a) If (and ONLY if) the "IOS" Test was not performed previously do so now. If (and ONLY if) IOS fails two of three times see procedure number AUTOTEST- 1.0.0 (page 231). If IOS passes or was already performed (and passed) continue to part b.

b) Referring to Figure 95 (page 232), DOUBLE clamp the tubing at valve #43's output nozzle (towards the **FRONT** of the machine). **BE CAREFUL! Avoid the tubing towards the rear of the machine!**

c) Repeat the Leak Test on Valve #43. Proceed accordingly:

- **Fails:** See procedure number AUTOTEST- 2.0.1 (page 233).
- **Passes:** Remove the clamps and repeat the Leak Test on valve #43. Proceed accordingly:
  - **Fails:** **NOTE** that valve #43 is the leaking valve then see procedure number AUTOTEST- 5.0.0 (page 234)
  - **Passes:** If other Leak tests are desired return to B. PERFORM LEAK TESTS (page 230).

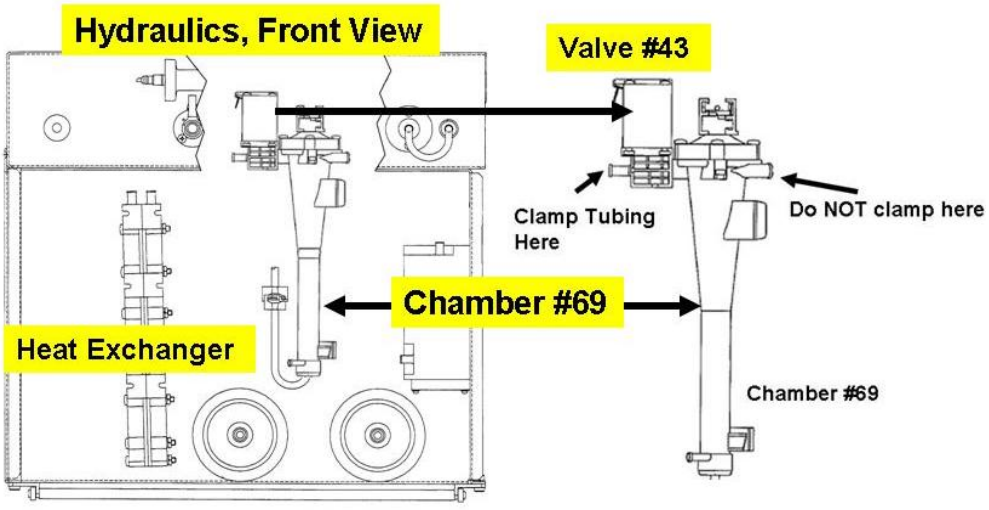


Figure 95 – Valve #43

AUTOTEST- 2.0.1 REPEAT TEST ON VALVE #31 AND #33 (CHECK UF PUMP)

Leak tests on Valve #43 require the UF pump to achieve pressure during the "Prep" phase. If the UF pump is malfunctioning other valves that require it will also fail (see Table 29, page 235). Perform Leak Tests on valves #31 and #33 and proceed accordingly:

- **Both Fail:** See procedure number AUTOTEST- 2.0.2 (page 233).
- **One or both passes:** See procedure number AUTOTEST- 2.0.4 (page 233).

AUTOTEST- 2.0.2 CHECK UF PUMP

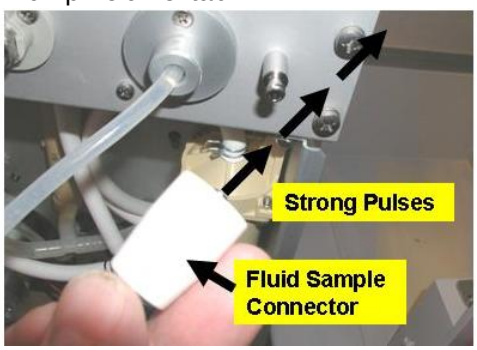
a) Select the screen's 'Calibrate Hydraulics' tab then select the 'UF Pump Volume' tab.

b) Press the 'CONFIRM' key. The screen changes.

c) Place the dialyzer quick connectors into a bucket of water on the floor and close the shunt door**. It's important the connectors remain submersed!**

d) Referring to the Figure (right), remove the Fluid Sample Connector from its port. **No need to attach a burette! The UF pump is not being calibrated!**

e) Press the blinking 'Prime' key. Ignore 5 strokes then watch 5. Does the UF pump deliver strong pulses during the last 5?



Yes See procedure number AUTOTEST- 2.0.3 (page 233).

No Remove the clamps from valve #43 and proceed to page 215, UF PUMP PROBLEMS.

AUTOTEST- 2.0.3 CHECK DIALYSATE PRESSURE SYSTEMS

With valve #43 remaining clamped, calibrate DIALYSATE PRESSURE per procedure. **Remember to close the shunt door!** Did an "Operator Error" message occur?

Yes Remove valve #43's clamps then see procedure number AUTOTEST- 6.0.0 (page 235).

No Remove valve #43's clamps then repeat A. INITIALIZING AUTOMATED LEAK TESTS (page 230).

AUTOTEST- 2.0.4 CHECK DIALYSATE PRESSURE SYSTEMS

Remove the clamps from valve #43 and repeat the Leak Test on Valve #43:

- **Valve #43 fails:** **NOTE** that valve #43 is leaking then see procedure number AUTOTEST- 5.0.0 (page 234)
- **Valve #43 passes:** Return to B. PERFORM LEAK TESTS (page 230) to repeat the Tests.

AUTOTEST- 3.0.0 ISOLATE 'DRAIN CIRCUIT' COMPONENTS

Because valve #30, #29 and the heat exchanger #77 share the 'drain circuit' a leak at any one will cause valve #29 to fail. The following procedure isolates these components. Four clamps are required:

a) If (and ONLY if) the "IOS" Leak Test was not performed previously do so now. If (and ONLY if) IOS fails two of three times see procedure number AUTOTEST- 1.0.0 (page 231). If IOS already performed (and passed) continue with part b.

b) Referring to Figure 96 (page 234), isolate valve #30, by tightly double clamp at two locations:

1) Valve #29's clear input tubing.

2) Both sides of the heat exchanger's 'to drain' (CLEAR) tubing.

c) Repeat the Leak Test twice on Valve #29. Does it pass both times?

Yes See procedure number AUTOTEST- 3.0.1 (page 234).

No a) Remove all clamps.

b) **NOTE** that Valve #30 is **leaking** then see procedure number AUTOTEST- 5.0.0 (page 234).

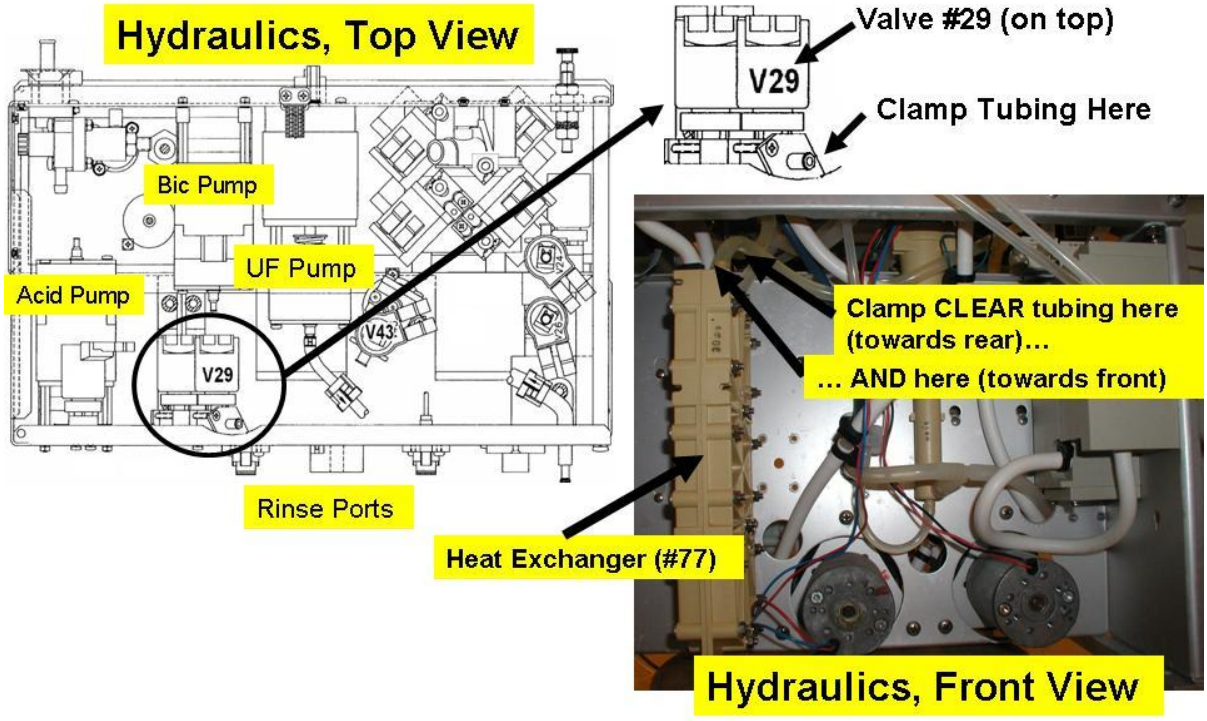


Figure 96 – Drain Circuit Checks

AUTOTEST- 3.0.1 ISOLATE THE HEAT EXCHANGER

Remove the heat exchanger's clamps and repeat the Leak Test twice on Valve #29. Does it pass both times?

Yes See procedure number AUTOTEST- 3.0.2 (page 234).

No The heat exchanger's internal plate (P/N 650775) may be leaking.

AUTOTEST- 3.0.2 ISOLATE VALVE #29

Remove valve #29's clamps and repeat the Leak Test twice on Valve #29. Does it pass both times?

Yes A leak is not indicated! Repeat the Leak Test on Valve #29 once more to verify.

No **NOTE** that valve #29 is **leaking** then see procedure number AUTOTEST- 5.0.0 (page 234).

AUTOTEST- 5.0.0 CHECK FOR A SHORTED ACTUATOR BOARD VALVE DRIVER

Two possibilities: 1) Bad actuator board; 2) Bad valve (mechanically leaking).

a) If (and ONLY if) the "IOS" Leak Test was not performed previously do so now. If (and ONLY if) IOS fails two of three times see procedure number AUTOTEST- 1.0.0 (page 231). If IOS was performed (and passed) continue with part b.

b) Turn the power off and swap in a known good actuator board (see Figure 4A, page 8).

c) If the **NOTED** leaking valve was (two scenarios):

1. **Valve #30:** Repeat the Automated Valve Leak Test on Valve #29. Proceed accordingly:
   - **Passes:** The previous actuator board is bad
   - **Fails:** Referring to Figure 39 (page 85) or Figure 40 (page 85), replace valve #30. The previous actuator board is probably good!
2. **Any other valve besides valve #30:** Repeat the Automated Valve Leak Test on the NOTED leaking valve. Proceed accordingly:
   - **Passes:** The previous actuator board is bad
   - **Fails:** Referring to Figure 39 (page 85) or Figure 40 (page 85), replace the NOTED **leaking valve**. The previous actuator board is probably good!

AUTOTEST- 6.0.0 TROUBLESHOOT DIALYSATE PRESSURE CALIBRATION

An "Operator Error" message occurred during DIALYSATE PRESSURE Calibration. Check the following:

1. ASSURE the four way assembly has been installed properly and its tubing is not pinched
2. ASSURE the **shunt door is closed**!
3. ASSURE the transducer protector at the external pressure meter is not wet
4. ASSURE that Dialysate flow is **turned off** when instructed
5. The [Dial Pressure Reference] data box normally stabilizes at approximately 100 at 0 mmHg and approximately 140 at -250 mmHg if the above 4 steps are performed correctly and the dialysate pressure transducer (#9) is good.
6. Turn the machine off, back on, and attempt the DIALYSATE PRESSURE calibration again. If the "Operator Error" message reoccurs, proceed to **page 177**, SECTION 9- TMP PROBLEMS to troubleshoot a potential dialysate pressure transducer problem.

Automated Valve Leak Test Theory: Automated Valve Leak Tests check Air Removal Chamber #69 for leaks to atmosphere (Integrity Of System ("IOS")), and for valves that are not closing due to mechanical failure or a bad actuator board.

Appropriate pressure is achieved during each "Prep" phase. Referring to Table 29, (page 235), some tests require 'negative' pressure (approx. -300 mmHg), achieved with the UF pump #22, others require 'positive' pressure (approx. +300 mmHg), achieved with loading pressure. During each "Testing" phase (except "IOS"), the 'valve to be tested' is closed and a leak path to is opened. During "IOS" all valves are closed to isolate Chamber #69. Pressure transducer #9 is read for 30 seconds. If pressure remains stable (+/- 25 mmHg) a leak is not indicated. **NOTE: Valves #39, #41, and #28, are not tested**.

Table 29 - Valve Pressures

Tests Requiring Negative Pressure (approx. -300 mmHg) during the "Prep" phase	Tests Requiring Positive Pressure (approx. +300 mmHg) during the "Prep" phase
Valve #43	IOS
Valve #31	Valve #32
Valve #33	Valve #34
Valve #35	Valve #36
Valve #37	Valve #38
Valve #26	Valve #29
Valve #24	----------
Valve #25	----------

SECTION 18B - MANUAL BALANCING CHAMBER VALVE LEAK TESTS

A. These tests should be performed if a leaking balancing chamber valve is strongly suspected and the automated valve leak test did not identify it or to validate an automated valve leak failure.

B. **Intensive work is done inside the distribution board, plugging and unplugging valves**. Referring to Figure 97 (page 236), assure that all balancing chamber valves (#31 - #38) have their distribution board connectors labeled correctly and are plugged into their correct positions.

C. A leak is verified through the top balancing chamber valve nozzles (after the tubing is removed). **Ignore small water crowns that may appear**. If a valve is leaking it will continually drip.

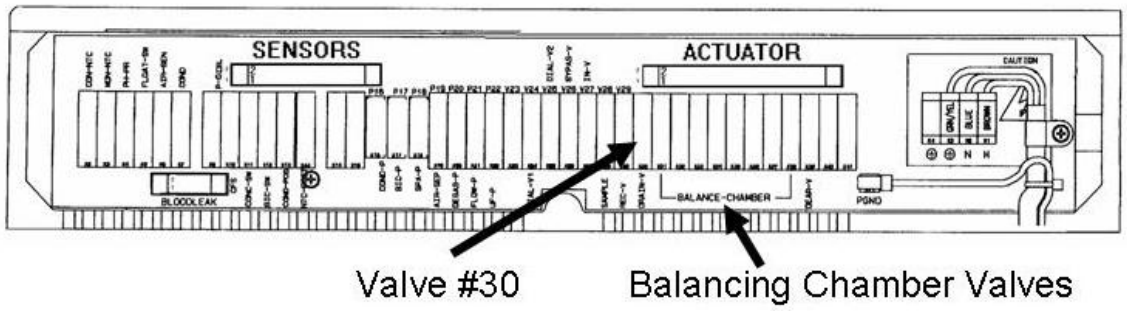


Figure 97 – Distribution Board

TOP SIDE LEAK PROCEDURE (Valves 31 – 34)

a) Referring to Figure 98 (page 237), turn the machine off and remove the clear tubing from all four top-side (OUTPUT) balancing chamber valves (#31 through #34).

b) Unplug valve #30 from distribution board position labeled V30, DRAIN-V and leave it unplugged until instructed otherwise.

c) Place both dialyzer quick connects into a bucket of water and close the shunt door.

d) Unplug all eight balancing chamber valves from the distribution board positions “V31” through “V38”.

e) Turn the machine on and enter Dialysis Program (remember to press the ‘CONFIRM’ key).

f) Ignore Flow Errors!

g) Call debug screen 0. ASSURE that **DEAP** AND **FLWP** are less than 255.

Theory: All eight balancing chamber valves should be closed (unless one is leaking). The following procedure opens the bottom valves, one at a time, using 24 volts from valve 30’s distribution board connector. Since the deaeration pump (P20) and flow pump (P21) are running the bottom valves are pressurized. If a top side valve is not sealing properly, a water leak will be seen through its exposed nozzle.

h) Plug valve #35 into valve #30’s distribution board position (V30, DRAIN-V). Watch the top side balancing chamber valve nozzles. Replace any valve that is seen leaking (either valve #31 or valve #32).

i) Unplug valve #35 and plug valve #36 into valve #30’s position (V30, DRAIN-V). Watch the top side balancing chamber valve nozzles. Replace any valve that is seen leaking (either valve #31 or valve #32).

j) Unplug valve #36 and plug valve #37 into valve #30’s position (V30, DRAIN-V). Watch the top side balancing chamber valve nozzles. Replace any valve that is seen leaking (either valve #33 or valve #34).

k) Unplug valve #36 and plug valve #38 into valve #30’s position (V30, DRAIN-V). Watch the top side balancing chamber valve nozzles. Replace any valve that is seen leaking (either valve #33 or valve #34).

l) Unplug valve #38 and leave it. None of the top side balancing chamber valves are leaking. Continue with BOTTOM SIDE LEAK PROCEDURE (page 237).

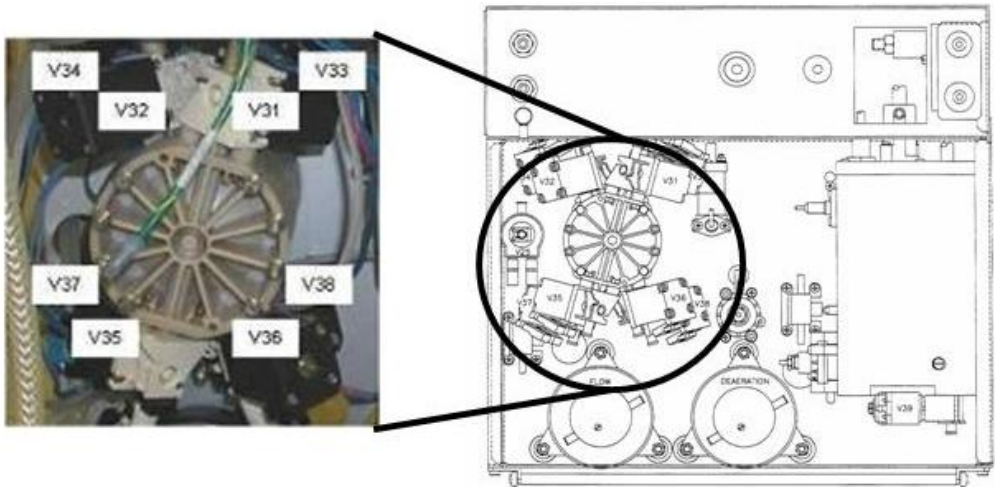


Figure 98 – Balancing Chamber Valves

BOTTOM SIDE LEAK PROCEDURE (Valves 35 – 38)

Theory: The following procedure opens the top side valves, one at a time, using 24 volts from valve 30's distribution board connector. Because the deaeration pump and flow pump are running the bottom valves are pressurized.

NOTE: **Needle nose pliers** are required (i.e. do NOT use a plastic clamp) to QUICKLY clamp valve #35's or valve #37's white tubing. Referring to Figure 98 (page 237), locate these valves at this time (left side, bottom).

a) Plug valve #31 into valve #30's distribution board position (V30, DRAIN-V) and watch valve #31's nozzle. Is a leak seen?

   Yes Quickly clamp valve #35's white tubing. If the leak stops replace valve #35. If not, replace valve #36.

   No See part b.

b) Plug valve #32 into valve #30's position (V30, DRAIN-V) and watch valve #32's nozzle. Is a leak seen?

   Yes Quickly clamp valve #35's white tubing. If the leak stops replace valve #35. If not, replace valve #36.

   No See part c.

c) Plug valve #33 into valve #30's position (V30, DRAIN-V) and watch valve #33's nozzle. Is a leak seen?

   Yes Quickly clamp valve #37's white tubing. If the leak stops replace valve #37. If not, replace valve #38.

   No See part d.

d) Plug valve #34 into valve #30's position (V30, DRAIN-V) and watch valve #34's nozzle. Is a leak seen?

   Yes Quickly clamp valve #37 white tubing. If the leak stops replace valve #37. If not, replace valve #38.

   No A balancing chamber valve leak is not obvious using this test. Turn the machine off and CAREFULLY plug all valves back into the distribution board. Place the machine into Dialysis Program and perform automated Alarm/Pressure tests.

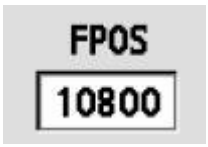
SECTION 19 - TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM

A torn balancing chamber diaphragm can cause Flow Errors and/or Temperature and/or Conductivity alarms. A 'restricted' or leaking balancing chamber valve or a bad flow pump may cause similar symptoms. The following procedure isolates these.

BC LEAK- 1.0.0 PREPARATION

a) Assure the machine has been running in Dialysis program for at least eight minutes connected to fresh concentrate.

b) Call debug screen 5. Referring to the Figure (right), is **FPOS** greater than 9000?



Yes See procedure number BC LEAK- 3.0.0 (page 240).

No See procedure number BC LEAK- 1.1.0 (page 238)

BC LEAK- 1.1.0 CHECK FLOW PUMP

This procedure uses a pressure (psi) gauge. **Assure it reads 0 psi before installing it!**

a) Place the dialyzer Hansen connectors into the shunt and close the door.

b) Plug the concentrate connectors into their respective rinse ports to call the "Select Concentrate" screen.

c) Referring to Figure 321, tee a pressure gauge between the flow pump's OUTPUT nozzle and the WHITE tubing.

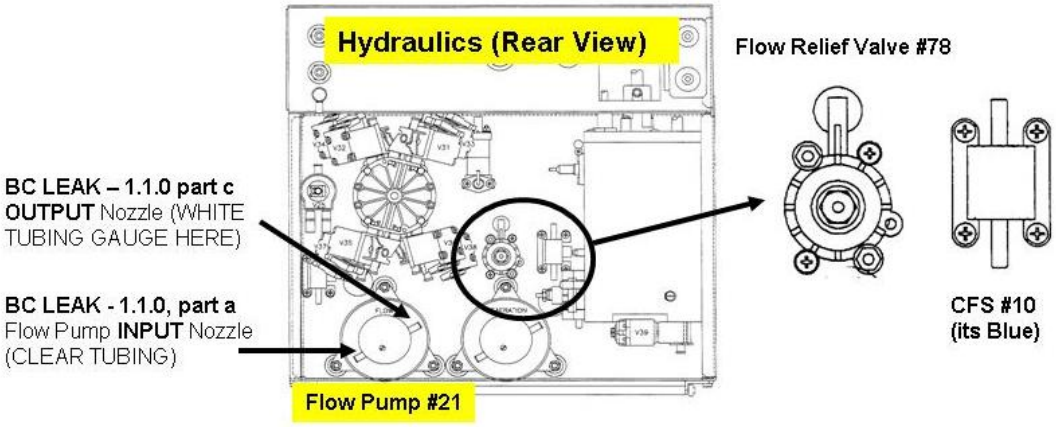

Hydraulics (Rear View)
Flow Relief Valve #78
BC LEAK – 1.1.0 part c
OUTPUT Nozzle (WHITE TUBING GAUGE HERE)
BC LEAK - 1.1.0, part a
Flow Pump INPUT Nozzle (CLEAR TUBING)
CFS #10
(its Blue)
Flow Pump #21

Figure 321 - Hydraulics (Rear View)

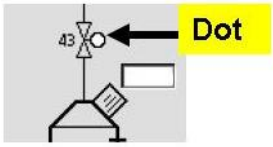
d) Place the machine into Rinse program. **Assure no leaks at the gauge! If the external flow indicator is NOT 'bobbing' up and down these tests are invalid!**

e) Pressure should fluctuate between a minimum and a maximum. The maximum depends on if the machine is DiaSafe® filter equipped. See Table N (page 238):

Table N – Flow Pump Pressure

DiaSafe Filter?	Maximum Pressure
Yes	35 – 36 psi
No	29 – 30 psi

f) Call debug screen 0 and allow valve #43's adjacent dot to turn blue (see Figure right). I**MPORTANT!** When it turns white again begin watching the gauge for one minute. Does it consistently reach its maximum pressure per Table N?



Yes See procedure number BC LEAK- 2.0.0 (page 239).

No See procedure number BC LEAK- 1.2.0 (page 239).

BC LEAK- 1.2.0 CHECK FLOW PUMP RELIEF VALVES #78

This is not a routine calibration. Follow the procedure below to avoid error!

a) Enter Service Mode → Calibrate Hydraulics → Flow Pressure.

b) Press the 'CONFIRM' key to start the flow pump. Assure its running **counterclockwise**!

c) **Without** adjusting valve #78, is pressure reaching Table N (page 238) maximum?

Yes Two possibilities: 1) Bad flow pump #21; 2) Bad flow pump motor (possibly bad brushes).

No See procedure number BC LEAK 1.3.0 (page 239).

BC LEAK- 1.3.0 CHECK FLOW MOTOR

Referring to Figure 321 (page 238), adjust Flow Relief Valve #78 (clockwise increases pressure). Are you able to reach the maximum pressure indicated in Table N (page 238)?

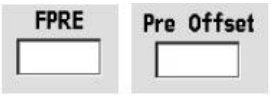
Yes a) NOTE: If the adjustment screw had to be turned in fully clockwise so that its threads are not visible three possibilities: 1) Bad flow pump #21; 2) Bad flow pump motor (possibly bad brushes); 3) Bad Flow Relief Valve #78.

b) Repeat procedure number BC LEAK- 1.1.0 (page 238) however if you return here, three possibilities: 1) Bad flow pump #21; 2) Bad flow pump motor (possibly bad brushes).

No Three possibilities: 1) Bad flow pump #21; 2) Bad flow pump motor (possibly bad brushes); 3) Bad Flow Relief Valve #78

BC LEAK- 2.0.0 DIAPHRAGM LEAK TEST

NOTE: Two buckets are required, one empty and the other filled with one gallon of pure acid concentrate. Read the procedure before continuing:



a) Call debug screen 5 and allow **FPRE** and **Pre Offset** to get within +/- 100 of each other (approximately 2300). This verifies that all conductive fluids have been rinsed out.

b) Pull the red concentrate connector from its port to "Interrupt" Rinse then plug it back in and return to Rinse.

c) Direct the UF sample connector tubing into the empty bucket to prevent pressure buildup.

d) **IMPORTANT!** Referring to Figure 319 (page 240), TIGHTLY clamp the clear tubing at valve #29's input nozzle. **Ignore Flow Errors for now!**

e) Open the shunt door and place the blue dialyzer quick connectors into the empty bucket.

f) Place the red dialyzer connector into the bucket of pure acid concentrate and assure it remains submersed.

g) **IMPORTANT! Do NOT shut the shunt door! The Rinse program must NOT interrupt!**

h) Watch **FPRE** CAREFULLY for three minutes. Does it increase (or fluctuate) to 3000 or greater at ANY time?

Yes A torn balancing chamber diaphragm is indicated. Remove the clamp from valve #29 then replace both balancing chamber diaphragms.

No See procedure number BC LEAK- 4.0.0 (page 241).

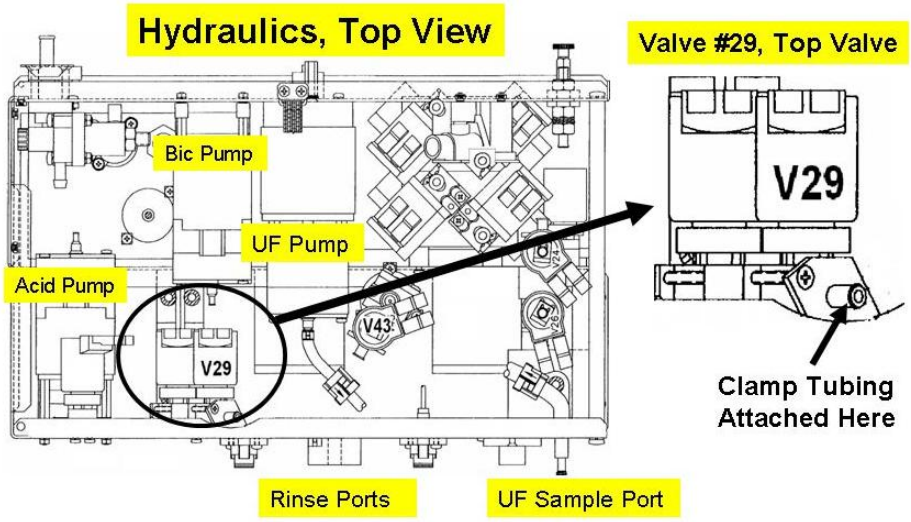


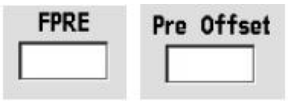
Figure 319 – Valve #29 Location

BC LEAK- 3.0.0 DIAPHRAM LEAK TEST PREPARATION

NOTE: Two buckets are required, one empty and the other filled with one gallon of pure acid concentrate. Read the procedures before continuing:

a) Place the machine into Rinse program. **If the external flow indicator is NOT 'bobbing' up and down these tests are invalid!**

b) Call debug screen 5 and allow eight minutes or until **FPRE** and **Pre Offset** are within +/- 100 of each other (approximately 2300). This verifies that all conductive fluids have been rinsed out.



c) NOTE **FPOS**! Typically between 2000 and 4000.

d) Pull the red concentrate connector from its port to "Interrupt" Rinse then plug it back in and return to Rinse.

e) Direct the UF sample connector tubing into the empty bucket to prevent pressure buildup.

f) **IMPORTANT!** Referring to Figure 319 (page 240), TIGHTLY clamp the clear tubing at valve #29's input nozzle. **Ignore Flow Errors for now!**

g) Open the shunt door and place the blue dialyzer quick connectors into the empty bucket.

h) Place the red dialyzer connector into a bucket of pure acid concentrate and assure it remains submersed.

i) **IMPORTANT!** Do NOT shut the shunt door! The Rinse program must NOT interrupt!

j) CAREFULLY watch **FPOS** for 45 seconds. Does it increase (or fluctuate) to greater than 6000 (usually much greater)?

Yes See BC LEAK- 3.2.0 (page 240).

No See procedure number BC LEAK- 1.1.0 (page 238) to check the flow pump.

BC LEAK- 3.2.0 PERFORM DIAPHRAGM LEAK TEST

Watch F**PRE** for three minutes. Does it increase (or fluctuate) to greater than 3000 at any time?

Yes A torn balancing chamber diaphragm IS indicated. Remove the clamp from valve #29 then replace both balancing chamber diaphragms.

No A torn balancing chamber is NOT indicated. See BC LEAK- 4.0.0 (page 241).

BC LEAK- 4.0.0 CHECK FOR RESTRICTED BALANCING CHAMBER VALVE

a) **IMPORTANT!** Remove the clamp from valve #29.

b) Return the dialyzer lines to the shunt and place the machine into Dialysis program (remember to press the 'Confirm' key) with fresh concentrate connected.

c) Call the Home screen. Set Dialysate flow to 500 ml/min (NOT "a500) and press the 'CONFIRM' key.

d) Allow five minutes. Is **Conductivity** greater than 16.5 mS?

Yes Proceed to **page 33,** procedure number **F- 7.0.2** to check for a restriction.

No See procedure number BC LEAK- 5.0.0 (page 241).

BC LEAK- 5.0.0 CHECK FOR A LEAKING BALANCING CHAMBER VALVE

a) Press and release the 'RESET' key and then press and hold it for three seconds. If the "Adjusting TMP" message is present allow it to expire. If a TMP alarm reoccurs attempt the RESET sequence up to twice more then continue.

b) Referring to Figure 318 (page 241), watch the (green or red) 'actual' TMP bar. TMP is STABLE if (and ONLY if) it REMAINS between the 0 and 520 limits AND varies less than +/- 40 mmHg in two minutes. Proceed accordingly (three scenarios):

1. **TMP is UNSTABLE if the 'actual' TMP bar rises (↑), greater than 40, towards the 520 Limit OR exceeds the 520 Limit causing a "TMP Is High" alarm:** See procedure number BC LEAK- 5.0.1 (page 241).
2. **TMP is UNSTABLE and the 'actual' TMP bar falls (↓), greater than -40, towards the lower 0 Limit OR falls below the 0 Limit causing a "TMP Is LOW" alarm:** See procedure number BC LEAK- 5.0.1 (page 241).
3. **TMP is STABLE:** If referred to TESTING FOR A LEAKING BALANCING CHAMBER DIAPHRAGM, return to the procedure that brought you here.

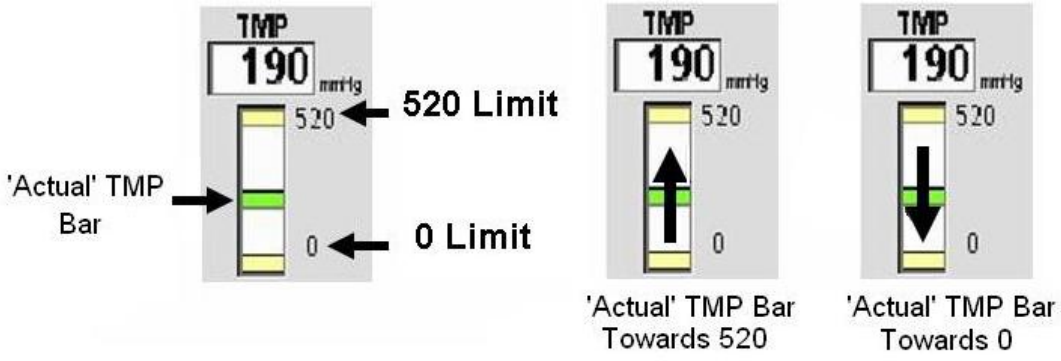


Figure 318 – TMP Bar Graph

BC LEAK- 5.0.1 TROUBLESHOOT

a) **NOTE** nine leak tests will be performed: **1)** IOS; **2)** Balancing Chamber Valves #31 through #38. See SECTION 18A – AUTOMATED VALVE LEAK TESTS (page 230).

b) If a valve leak is NOT located proceed to **page 33**, procedure number **F- 7.0.2**.

SECTION 20 – TROUBLESHOOTING OVERFLOW FROM THE VENT TUBE

A. Perform INITIAL CHECKS (page 6).

A. Referring to the Figure (right), proceed accordingly (three scenarios):

1. **Massive 'arching' overflow (greater than 600 ml/min):** See procedure number OVER- 6.0.0 (page 246).
2. **Slow 'dripping' overflow in Cleaning / Disinfection Programs (especially Heat Disinfect):** See procedure number OVER- 2.0.0 (page 242).
3. **Slow 'dripping' overflow in Dialysis Program:**

   a) **IMPORTANT!** If **Flow Error** (debug screen 0) = 1 **OR** a Filling Program (debug screen 1, **FILACT** = 1) is occurring '**slow**' overflow from the vent tube is normal. **Do NOT troubleshoot overflow if a Flow Error or Filling Program is present!**

   b) If (and only) if **Flow Error** = 0 AND **FILACT** = 0, see procedure number OVER- 1.0.0 (page 242).

OVER-1.0.0 CHECK FOR CENTRAL (SDS) CONCENTRATE DELIVERY

High central concentrate (SDS) pressure (greater than 2 psi) may force through the concentrate pump(s). Proceed accordingly:

- **The red and/or blue concentrate connector is attached to a central system:** See procedure number OVER- 1.0.1 (page 242).
- **BOTH the red and blue concentrate connectors are attached to a jug:** See procedure number OVER- 2.0.0 (page 242).

OVER- 1.0.1 CHECK FOR CENTRAL HIGH PRESSURE (Slow Overflow)

Turn Dialysate flow OFF (Dialysate Flow on/off LED blinks) and disconnect the connector(s) from the central supply. **Allow two minutes**. Does vent tubing overflow stop?

Yes — Acid and/or bicarbonate central pressure is too high. NOTE: Installing the 6 psi check valve(s) (P/N 150209, white insert) into the concentrate pump input tubing may help.

No — See procedure number OVER- 2.0.0 (page 242).

OVER- 2.0.0 CHECK FOR LEAKING HEAT EXCHANGER #77 (Slow Overflow)

NOTE: Steam and possibly small over flow (a cup or less) is normal in Heat Disinfect

a) **IMPORTANT!** Turn the machine off!

b) **IMPORTANT!** ASSURE the water is on!

c) Referring to Figure 99 (page 243) remove the front clear tubing (to drain) from the heat exchanger.

d) Watch for one minute. Ignore a water crown that may appear. Is water is continually dripping from the open heat exchanger nozzle?

Yes — Replace the heat exchanger's plate (P/N 650775).

No — Reattach the tubing to the heat exchanger then see procedure number OVER- 3.0.0 (page 243).

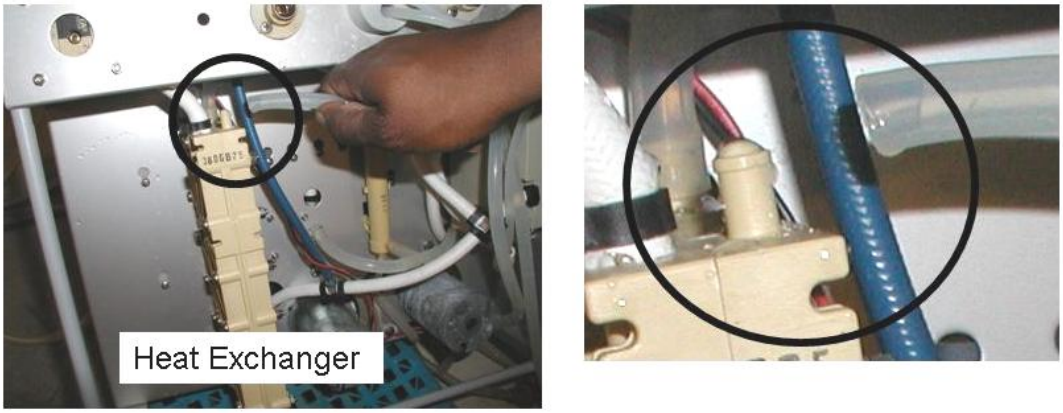


Figure 99 – Heat Exchanger Check

OVER- 3.0.0 CHECK INLET WATER PRESSURE (Slow Overflow)

This procedure uses a pressure (psi) gauge to check Inlet Water Pressure Regulator #61. **Assure the gauge reads 0 psi before installing it!**

a) Assure incoming water (RO source) pressure is no greater than 105 psi.

b) **IMPORTANT!** Turn the water off. Referring to Figure 100 (page 243), install the gauge at Inlet Pressure Regulator #61.

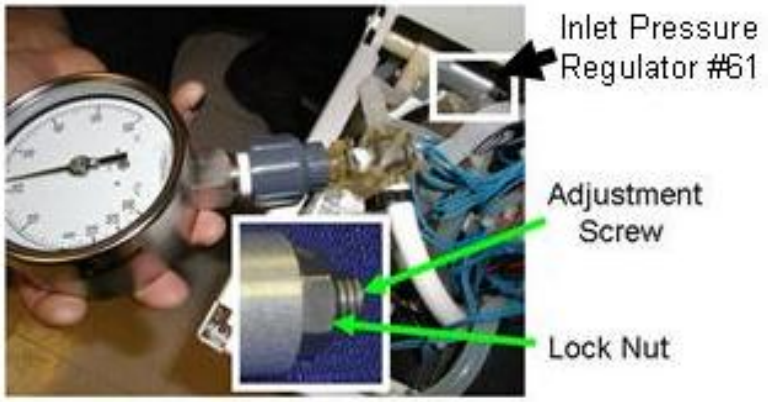


Figure 100 – Hydraulics TOP View / Inlet Pressure Regulator #61

c) **IMPORTANT!** Turn the water on!

d) Place the machine into Dialysis program (remember to press the 'CONFIRM' key).

e) Normally pressure fluctuates between a maximum of no greater than 20 psi and to a minimum of no less than 8 psi. Is the **maximum** greater than 20 psi?

Yes
a) Loosen Regulator's #61's lock nut and turn the adjustment screw **counterclockwise** until a maximum of between 18 and 20 psi is achieved. If pressure will not adjust incoming water pressure is too high (greater than 105 psi) OR regulator #61 is bad.

b) Leaving the gauge installed, see procedure number OVER- 3.0.1 (page 244).

No
a) Leaving the gauge installed, if pressure remains less than 10 psi ASSURE the water is on!

b) See procedure number OVER- 3.0.1 (page 244).

OVER- 3.0.1 CHECK INLET PRESSURE REGULATOR (Slow Overflow)

This procedure checks that Inlet Pressure Regulator #61 'maintains' pressure over time:

a) **IMPORTANT!** Turn the machine **OFF**.

b) Allow 20 minutes (or longer), is gauge pressure **greater than** 22 psi?

Yes Regulator #61 is bad or incoming water pressure is too high (greater than 105 psi).

No See procedure number OVER- 4.0.0 (page 244).

OVER- 4.0.0 CHECK FOR LEAKING INLET WATER SYSTEM (Slow Overflow)

a) Referring to Figure 101 (page 244), on top of the hydro chamber (newer machines) or hydro block (older machines) is the 'air gap chamber'.

b) With the machine **OFF**, remove the tubing that enters the 'air gap chamber' **vertically** from the top. This tubing is from inlet water valve #41. **CAUTION! Avoid the vent tubing!**

c) **IMPORTANT!** ASSURE the water is on!

d) Watch for two minutes. Does water continually drip **from the tubing**?

Yes Leaving the tubing disconnected, see procedure number OVER- 4.0.1 (page 244).

No Valve #41 is okay, see procedure number OVER- 5.0.0 (page 245).

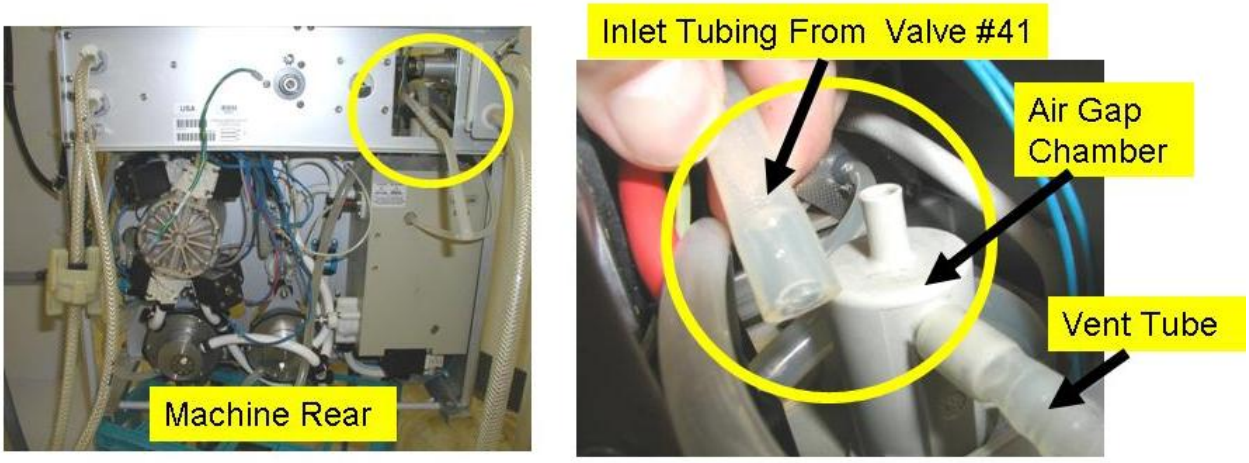


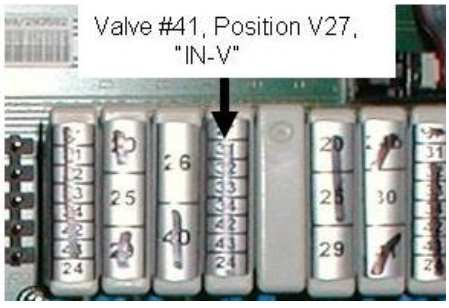
Figure 101 – Valve #41 Check

OVER- 4.0.1 CHECK VALVE #41 (Slow Overflow)

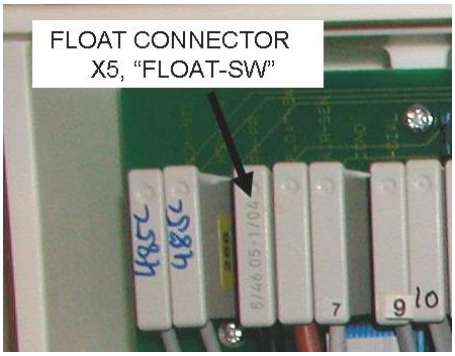
Referring to the Figure (right), unplug valve #41 from distribution board position labeled "**V27, IN-V**". Watch for one minute. Does the dripping continue?

Yes Replace valve #41 (leaking).

No Leaving the tubing disconnected, see procedure number OVER- 4.0.2 (page 245).



OVER- 4.0.2 CHECK THE FLOAT SWITCH #5 (Slow Overflow)



a) Referring to the Figure (right), unplug the float from distribution board position labeled "FLOAT-SW" (**3rd connector from the left**).

b) Using a flashlight, check inside the vacant x5 and position for 'white' corrosion or damaged **male** pins that may cause false signals.

c) If the distribution board is okay, watch for one minute. Does the dripping continue?

Yes Replace the actuator board (see Figure 4A, page 8).

No Replace float switch #5 (see Figure 28, page 59).

OVER- 5.0.0 CHECK VALVE #39 (Slow Overflow)

Valve #39 opens in the Cleaning Programs to relieve deaeration pressure. This is especially important in Heat Disinfect to prevent boiling which may cause vent tubing overflow!.

a) Re-attach the 'air gap chamber' tubing.

b) Referring to Figure 102 (page 246), attach the deaeration gauge between the inlet (clear tubing) and the deaeration pumps input nozzle. **Assure the gauge reads 0 inHg before attaching it**.

c) Place the machine into **Rinse** program. Gauge pressure between 0 and -15 inHg?

Yes Valve #39 is okay! See procedure number OVER- 5.0.2 (page 245).

No See procedure number OVER- 5.0.1 (page 245).

OVER- 5.0.1 ISOLATE VALVE #39 / ACTUATOR BOARD

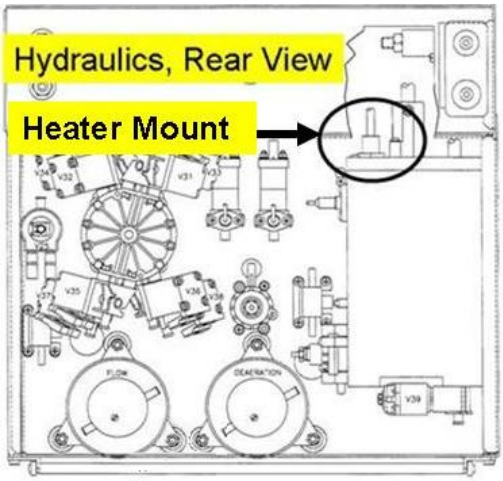
a) **IMPORTANT!** Allow Rinse program to continue for seven minutes.

b) Referring to Figure 102 (page 246), valve #39 is mounted to the bottom of the hydro block or hydro chamber. Touch valve #39's (black) solenoid. Is it warm (i.e. energized)?

Yes The actuator board is okay. Valve #39 is bad.

No **NOTE** that VALVE #39 (ONLY) will be checked and proceed to page 78, TROUBLESHOOTING VALVES.

OVER- 5.0.2 FINAL CHECKS



a) Turn the machine off.

b) Referring to the Figure (right), remove the heater and check its port into the top of the hydro block/hydro chamber for heat related damage (i.e. melting). If (and ONLY if) damage is located it will be necessary to replace the hydro block/hydro chamber.

c) Reinstall the heater.

d) All systems that cause vent tubing overflow are **initially** checking okay. If overflow continues, float switch #5 may be bad (see Figure 28, page 59).

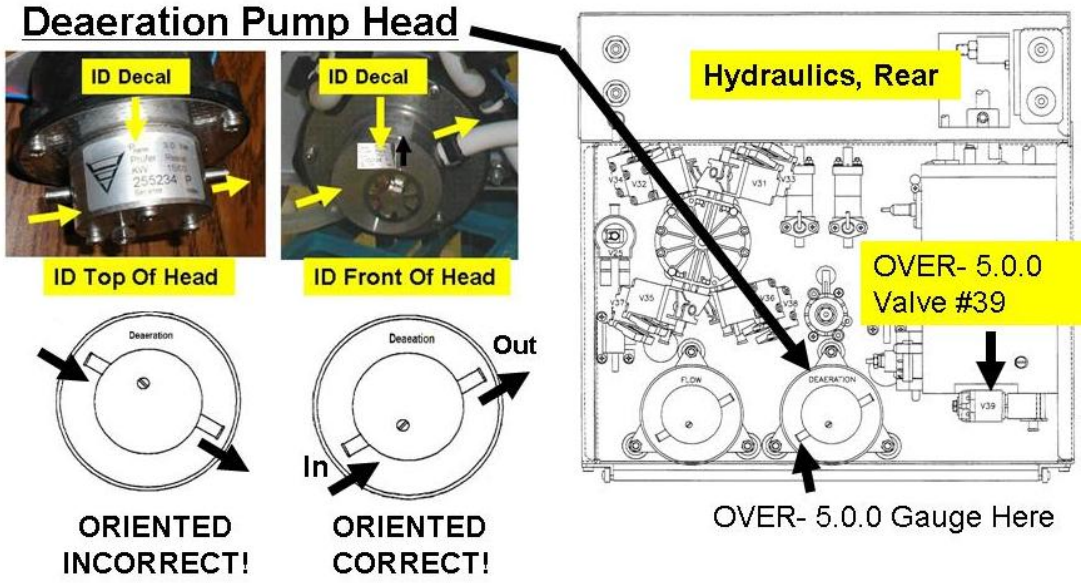
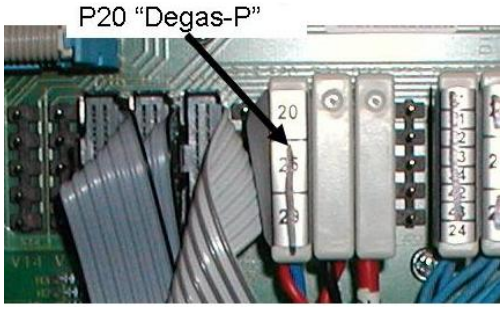


Figure 102 – Deaeration Pump Head

OVER- 6.0.0 MASSIVE OVERFLOW



Use these procedures when there is 'massive arching' overflow (greater than 600 ml/min) from the vent tubing.

a) Referring to the Figure (right) unplug the deaeration pump (#20) from distribution board position labeled "P20, Degas-P". Allow up to 30 seconds.

b) **IMPORTANT!** The machine AND the water MUST be on!

c) Does 'massive' overflow continue?

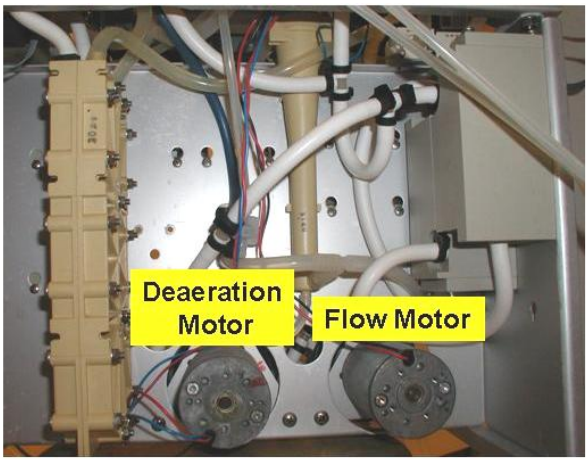
Yes See procedure number OVER- 7.0.0 (page 247).

No Three checks:

1) Referring to Figure 102 (page 246), if the deaeration pump head is oriented correctly its 'ID Decal' should be either on top or front. If on the front it should be right side up. **If the head is oriented incorrectly this is the problem!**

2) CAREFULLY return the deaeration pump to distribution board position "P20, "Degas-P". Referring to Figure 103 (page 247) if (and ONLY if) the DEAERATION motor shaft is rotating **clockwise** see procedure number MOTORS- 2.0.0 (page 60). **NOTE: If not rotating it was plugged in incorrectly! It should rotate counterclockwise!**

3) See procedure number OVER- 5.0.2 (page 245).



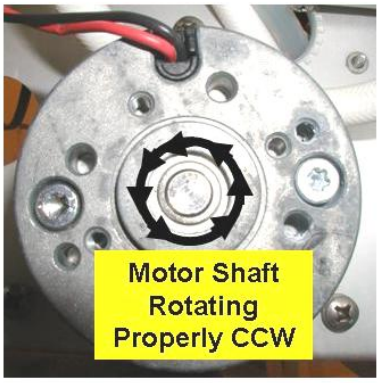
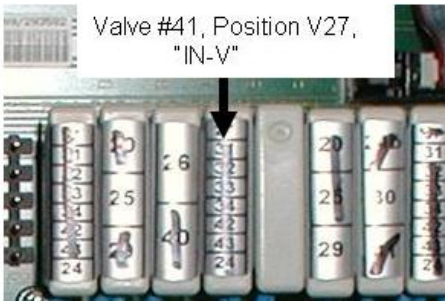


Figure 103 – Hydraulics (FRONT) View / Pumps

OVER- 7.0.0 CHECK VALVE #41



With the water and machine on:

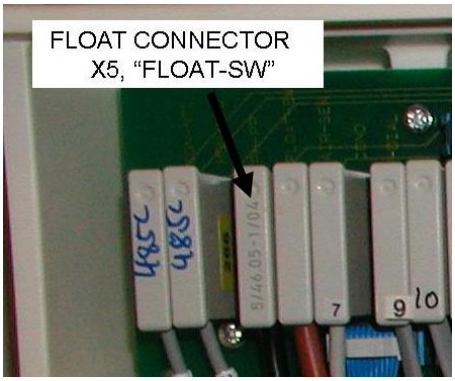
Referring to the Figure (right), unplug valve #41 from distribution board position V27, "IN-V". Does 'massive' overflow continue?

Yes a) Check inside the vacant V27, "IN-V" position for 'white' corrosion or damaged **male** pins.

b) Two possibilities: 1) Bad valve #41; 2) Bad distribution board.

No See procedure number OVER- 7.0.1 (page 247).

OVER- 7.0.1 CHECK FLOAT SWITCH (Massive Overflow)



With the water and machine on:

a) CAREFULLY return valve #41 to distribution board position labeled "IN-V, "V27 or "P27". If (and ONLY if) 'massive' overflow happens again proceed to part b.

b) Referring to the Figure (right), unplug the float from distribution board position labeled "FLOAT-SW" (**3rd connector from the left**). Does 'massive' overflow continue?

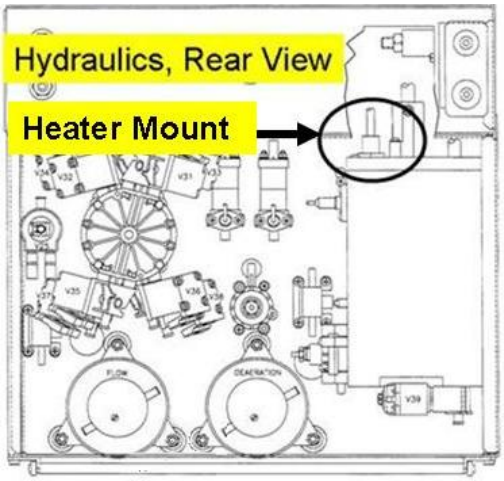
Yes Replace the actuator board (see Figure 4A, page 8)

No a) Check inside the vacant "FLOAT-SW" position for 'white' corrosion or damaged **male** pins.

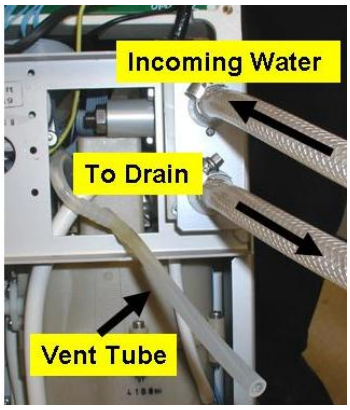
b) Referring to the Figure (right), remove the heater and check its port into the top of the hydroblock/hydrochamber for heat related damage (i.e. melting). If (and ONLY if) damage is located it will be necessary to replace the hydroblock/hydrochamber.

c) Reinstall the heater.

d) If massive overflow continues, three possibilities: **1)** Bad float switch (see Figure 28, page 59); **2**) Bad actuator cable; **3)** Bad distribution board.



SECTION 21 – LARGE HYDRAULIC LEAKS



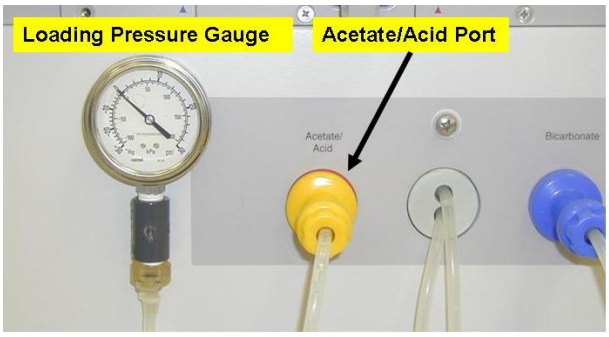
A) Turn the machine off.

B) Referring to the Figure (right), ASSURE the incoming water and drain tubing are not reversed!

C) If (and ONLY if) there is overflow from the vent tube proceed to **page 242**, SECTION 20 – TROUBLESHOOTING OVERFLOW FROM THE VENT TUBE.

D) ASSURE the water is on!

E) Assuring the loading pressure gauge reads 0 psi before inserting, **SLAM** it into the red Acetate/Acid rinse port (see Figure below, right).



F) Turn the machine on. During the power on sequence (at 90%) the deaeration pump turns on. Maximum pressure greater than 28 psi?

Yes — Proceed to **page 19**, procedure number F- 2.0.5.

No — Place the machine into Dialysis program (remember to press the 'CONFIRM' key) then see procedure number LEAKING- 1.0.0 (page 248).

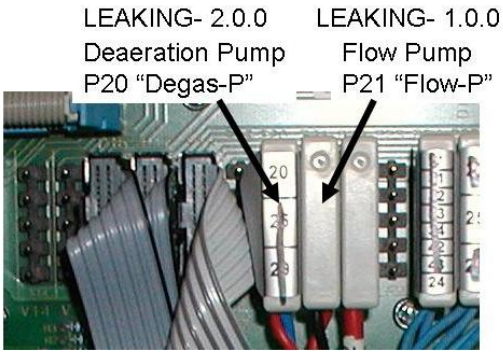
LEAKING- 1.0.0 DISABLE THE FLOW PUMP (SECONDARY SIDE LEAK?)

a) Referring to Figure 104 (page 248), unplug the Flow Motor (#21) from distribution board position P21, "FLOW-P". ASSURE the **FLOW MOTOR** shaft stops rotating!

b) Dry the leak site and allow 30 seconds. Does the leak remain active?

Yes — See procedure number LEAKING- 2.0.0 (page 249).

No — See procedure number LEAKING- 3.0.0 (page 250).



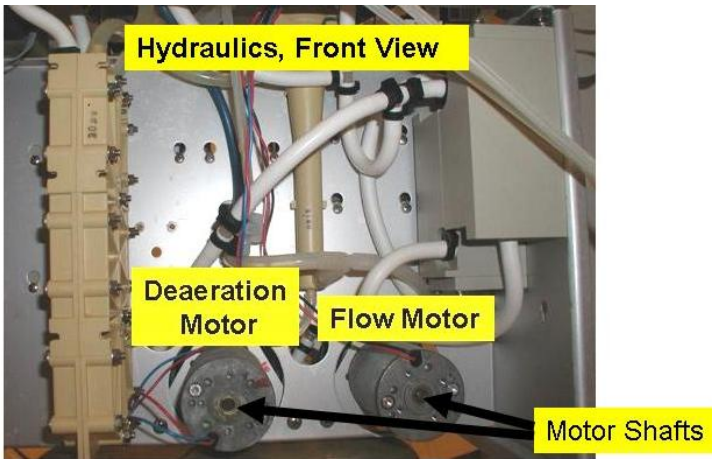


Figure 104 – Distribution Board / Hydraulics (FRONT View) Motors

LEAKING- 2.0.0 DISABLE THE DEAERATION PUMP (PRIMARY SIDE LEAK?)

Turn the machine off. Dry the leak site and allow 30 seconds. Does the leak remain active?

Yes See procedure number LEAKING- 2.0.1 (page 249).

No See procedure number LEAKING- 2.0.2 (page 249).

LEAKING- 2.0.1 PRIMARY SIDE LEAK

Read the list below (not inclusive) and proceed accordingly:

- **Leak from heat exchanger #77 tubing:** 1) Check Inlet Water Pressure Regulator per Calibration Procedures (18 – 20 psi); 2) Check tie wraps or replace tubing
- **Leak from heat exchanger #77 seal or screws:** 1) Assure incoming water pressure is no greater than 105 psi; 2) Check Inlet Water Pressure Regulator per Calibration Procedures (18 – 20 psi); 3) Repair or replace the heat exchanger
- **Leak from valve #39 (mounted on the bottom of the hydro block or hydro chamber):** 1) Check tubing connection; 2) Tie wrap or replace tubing; 3) Check o-ring; 4) The valve body may be leaking
- **Leak at reinforced tubing attached to hydro block/ hydro chamber:** Tie wrap or replace the tubing.
- **Leak between regulator #61 and valve #41 (not including the heat exchanger):** 1) Assure incoming water pressure is not exceeding 105 psi; 2) Check Inlet Water Pressure Regulator per Calibration Procedures (18 – 20 psi); 3) If 1 and 2 are okay, check tubing connections tie wraps or replace tubing; 4) If **valve #41** is leaking check the tubing connection, o-ring, or the valve body may be leaking

LEAKING- 2.0.2 PRIMARY SIDE LEAK

Read the list below (not inclusive) and proceed accordingly:

- **Leak from heat exchanger #77 tubing:** Check tie wraps or replace tubing
- **Leak from heat exchanger #77 seal or screws:** Repair or replace the heat exchanger
- **Leak from the acid and/or bicarbonate pump reinforced tubing. Tubing may be 'blowing' off:** Tie wrap or replace the tubing
- **Leak from RINSE PORT tubing connections (inside the machine):** Check tubing connections tie wraps or replace the tubing
- **'Spraying' from either RINSE PORT:** The internal, spring loaded, poppet valve is not sealing. Insert a dull probe and press the valve back and forth a few times to clear possible debris (possibly from a concentrate connector o-ring)*. If spraying continues, replace the port. *Recurring debris see procedure number LEAKING- 4.0.0 (page 248)
- **Leak between the deaeration pump #20 and the hydro chamber (including the mixing chambers #82):** Check tubing connection tie wraps or replace the tubing
- Referring to Figure 105 (page 250):
  - **Leak is between the BOTTOM BALANCING CHAMBER VALVES, #35 and #37 and the hydro chamber:** 1) Check tubing connections and tie wraps; 2) Check o-ring seal; 3) The valve body may be leaking
  - **Leak is between the TOP BALANCING CHAMBER (BC) VALVES #32 and #34 and DRAIN VALVE #30:** 1) Check tubing connections and tie wrap or replace the tubing; 2) Possible bad o-ring seal on BC valves 3) The valve body may be leaking

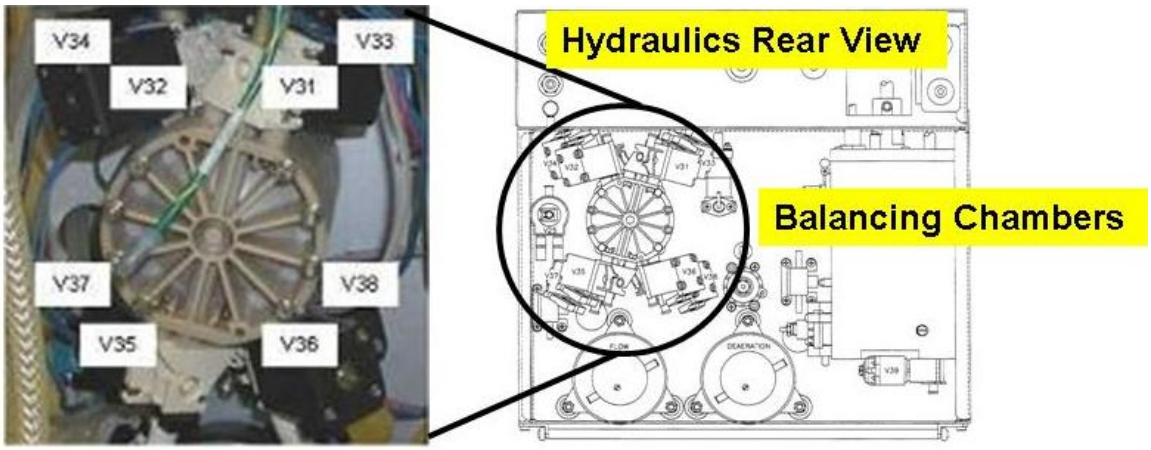


Figure 105 – Balancing Chambers

LEAKING- 3.0.0 SECONDARY SIDE LEAK

Referring Figure 105 (page 250), is the leak in the white reinforced tubing (including connections) between the flow pump and the **BOTTOM BALANCING CHAMBER VALVES**, #36 and #38?

Yes a) Tighten or replace the tubing clamps. Replace the tubing if necessary.

b) CAREFULLY return the flow and deaeration pumps to their respective distribution board positions (Deaeration pump = P20-"DEGAS-P"; Flow pump = P21-"FLOW-P").

c) Check FLOW PRESSURE CALIBRATION per Preventative Maintenance procedures. If unable to calibrate to less than 36 psi, Flow Pump Relief Valve #78 is bad or plugged with debris. If debris is located see procedure number LEAKING- 4.0.0 (page 248).

d) Possible bad o-ring seal to balancing chamber or possible valve body leak

No Proceed accordingly (three scenarios):

1. **If the (optional) DiaSafe® filter was leaking from the headers:** Replace the filter.
2. **If the leak is from inside the (optional) DiaSafe® Plus filter housing:** See procedure number LEAKING- 3.0.1 (page 250).
3. **All other scenarios:** See procedure number LEAKING- 3.0.1 (page 250).

LEAKING- 3.0.1 ISOLATE SECONDARY SIDE LEAK

a) Tie wrap the leaking tubing connection and dry the leak site.

b) CAREFULLY return the flow and deaeration pumps to their respective distribution board positions (Deaeration pump = P20-"DEGAS-P"; Flow pump = P21-"FLOW-P").

c) Does a leak reappear somewhere else?

Yes See procedure number LEAKING- 3.0.2 (page 251).

No a) Place the machine into Rinse program for 30 seconds.

b) Return to Dialysis program (remember to press the 'CONFIRM' key).

c) Allow three minute then call debug screen 0 and check **Flow Error**.

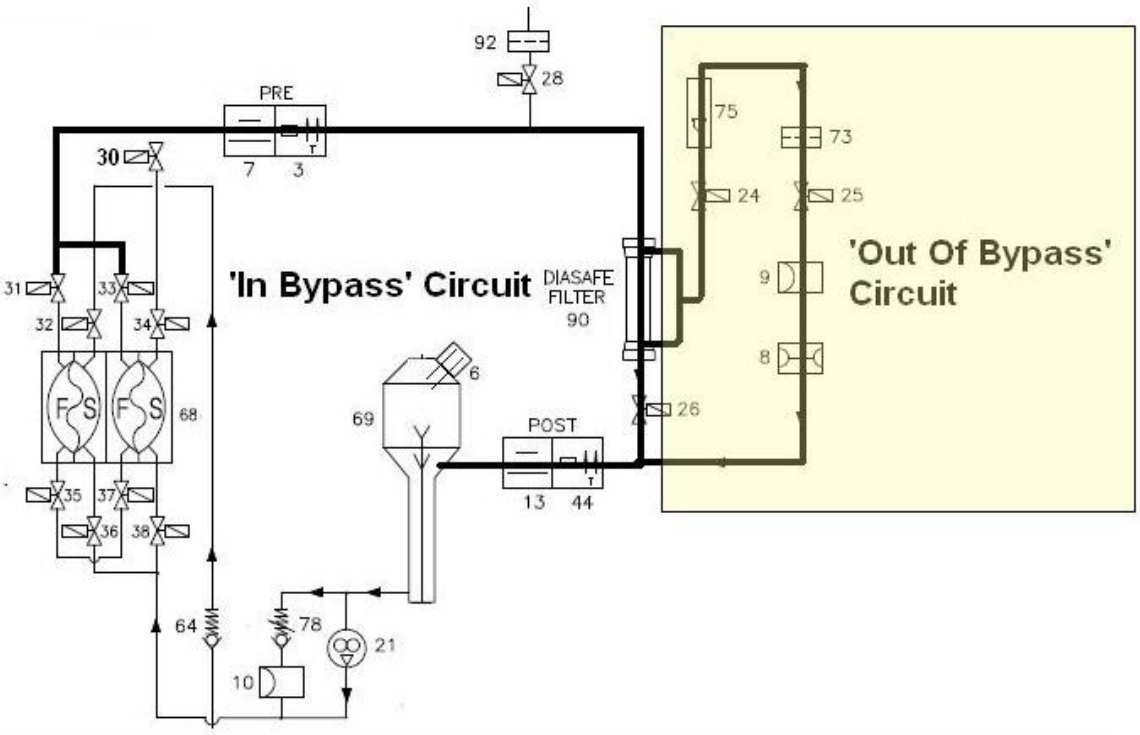


Figure 106 – Abbreviated Flow Diagram

LEAKING- 3.0.2 ISOLATE THE LEAK

a) **IMPORTANT!** Open the shunt door (Bypass LED on) and dry the leak site.

b) Allow 30 seconds. Does a leak reappear (somewhere)?

Yes Referring to Figure 106 (page 251), possible restriction in the 'In Bypass' circuit. Proceed to **page 33**, procedure number **F- 7.0.2**.

No Referring to Figure 106 (page 251), possible restriction in the 'Out Of Bypass' circuit is indicated. Proceed to **page 48** procedure number **F- 14.0.0**.

LEAKING- 4.0.0 DEBRIS LOCATED

Debris may indicate: A) **Old style hydro block ONLY:** 1) 'Rod baffle' degradation in chamber E (see Figure 28, page 59); 2) Excessive o-ring lubrication at the restrictor o-rings; 3) O-ring debris (if the restrictor o-rings are/were broken). B) **New Style Hydro chamber AND Old style Hydro Block:** 1) Inadequate acid clean cycles (causing excessive bicarbonate precipitate); 2) Inadequately filtered incoming water.

SECTION 23 – HEAT RELAY TEST FAIL

Heater relay #3 (RL3) is controlled by the function board via the power logic board's transistor (T5) and remains on if Temperature is less than 41° C (in Dialysis), 90 °C (in Heat Disinfect). In the event of temperature control failure RL3 turns off. RL3 is tested during the first 10 seconds of Dialysis program. If it does not turn off properly a "Heat Relay Test Fail" message is issued.

HEATER RELAY- 1.0.0 VALIDATE THE HEATER RELAY TEST ALARM

a) Turn the machine off to RESET the alarm.

b) Turn the machine back on and place it into Dialysis Program (remember to press the 'CONFIRM' key).

c) Does the alarm reoccur?

Yes See procedure number HEATER RELAY- 1.0.1 (page 252).

No There is no need to continue!

HEATER RELAY- 1.0.1 CHECK DEBUG SCREEN 2 (HEAT) / ISOLATE THE POWER CONTROL BOARD

a) Turn the machine off.

b) Turn the machine on and allow the "Select Program" screen to appear.

c) Select the screen's Dialysis button to call the "Select Concentrate" screen but **do NOT** 'CONFIRM' the concentrate.

d) Call debug screen 2. **TRIAC** (3rd column from the left) is?

TRIAC = 1 See procedure number HEATER RELAY- 2.0.0 (page 254).

TRIAC = 0 The function board 'thinks' the heater relay is on and providing current to the heater. See procedure number HEATER RELAY- 1.0.3 (page 252).

HEATER RELAY- 1.0.3 ISOLATE THE HEATER

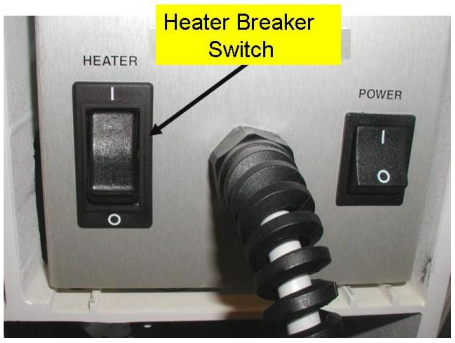
a) Leave the machine in 'No Program'.

b) Referring to the Figure (right), at the rear of the machine, turn the HEATER switch OFF (i.e. pressed in towards "0" or "OFF").

c) Debug screen 2 **TRIA**C is?

TRIAC = 1 See procedure number HEATER RELAY- 2.0.0 (page 254).

TRIAC= 0 See procedure number HEATER RELAY- 1.0.4 (page 252).



HEATER RELAY- 1.0.4 ISOLATE THE POWER LOGIC BOARD

CAUTION! DC Voltages will be measured at pins that are close together and 'shorting' them with a regular meter probe may damage several boards. It is HIGHLY RECOMMENDED the Fluke TP 80 meter probe (or equivalent), together with the protective cap (see Figure 5, page 11) is used!

a) Turn the machine off.

b) Open the card cage. Place a volt meter's ground (black) lead at chassis ground (see Figure 1, page 3).

c) Referring to Figure 112 (page **Error! Bookmark not defined.**), assure the 24V POWER harness is plugged securely into the motherboard.

d) Turn the machine on and allow the "Select Program" screen to appear.

e) Select the screen's Dialysis button to call the 'Select Concentrate' screen but **do NOT** 'CONFIRM' the concentrate. This is No Program'.

f) Referring to Figure 110 (page 253), **place the TP 80 meter probe** at the solder (rear) side of the power logic board's X2 connector, *pin 5* (bottom row, 3 pins from the rear of machine).

g) The measurement at pin 5 is:

Between 0 and 1.7 volts DC: Replace the power control board (inside the power supply). IC1 or IC2 is bad.

Between 1.7 and 6.0 volts DC: See procedure number HEATER RELAY- 1.0.5 (page 253).

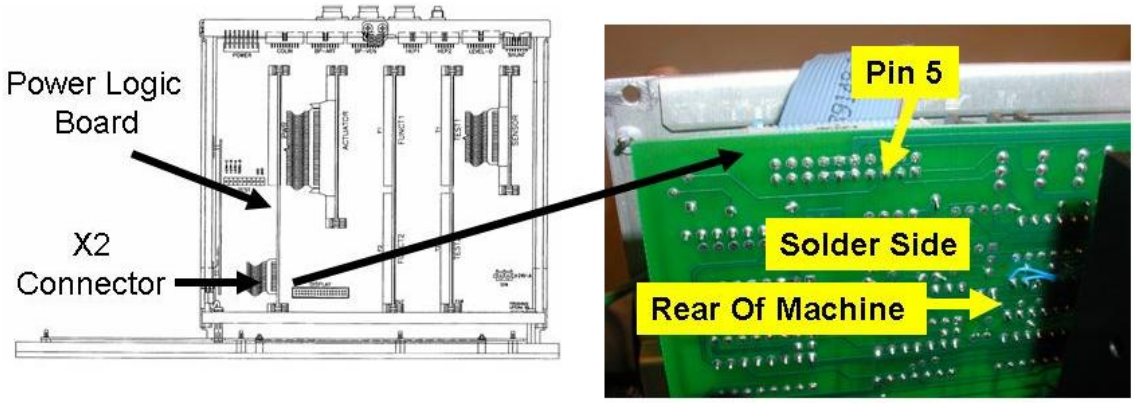


Figure 107 – Power Logic Pin 5

HEATER RELAY- 1.0.5 CHECK THE POWER CONTROL BOARD / POWER LOGIC BOARD

a) Turn the power off and unplug the machine. **Caution! High Voltage if not unplugged!**

b) Referring to Figure 111 (page 254) open the power supply to access the front (component) side of the power control board. **Unplug the X2 cable from the top of the power control board.**

c) A bad diode 17 will damage the power logic board. Check diode 17's resistance (Ω)* (see Figure 111) by placing the meter leads on either side of it.

d) Is the meter's numeric AND units display indicating a resistance between 500 and 1500 Ω (or between 0.50 KΩ and 1.5 KΩ)?

Yes The diode is okay. See procedure number HEATER RELAY- 1.0.6 (page 253).

No Replace the power control board (or diode 17 (1N914B)). The power logic board is probably bad also (see Figure 4A and NOTE B, page 8). After board or diode replacement see procedure number HEATER RELAY- 1.0.6 (page 253).

*** NOTE: The meter's diode check function will not work because the diode is 'in circuit'**

HEATER RELAY- 1.0.6 CHECK THE POWER CONTROL BOARD / POWER LOGIC BOARD

a) Return the X2 cable to the power control board.

b) Swap in a known good power logic board (see Figure 4A and NOTE B, page 8).

c) Turn the machine on and place it into Dialysis program (remember to press the 'CONFIRM' key). Does the Heater Relay alarm reoccur?

Yes Replace the function board (see Figure 4A, page 8). The previous power logic board is good.

No Problem solved! The previous power logic board is bad (IC19).

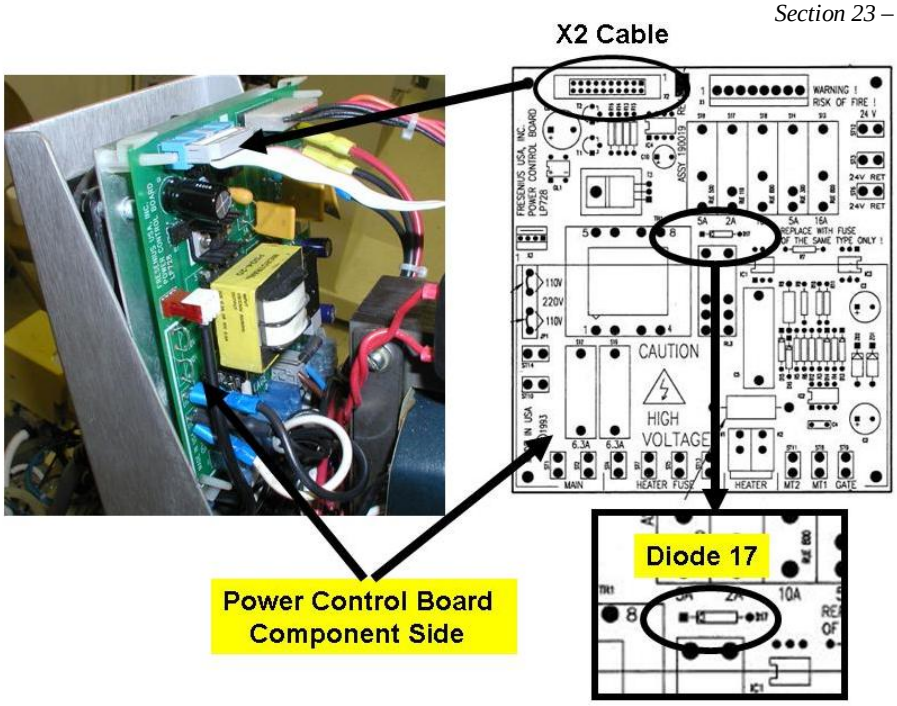


Figure 108 – Power Control Board (Diode 17)

HEATER RELAY- 2.0.0 CHECK DIODE 17

a) Turn the power off and unplug the machine. **Caution! High Voltage if not unplugged!**

b) Referring to Figure 111 (page 254), open the power supply to access the front (component) side of the power control board.

c) **Unplug the X2 ribbon cable from the top of the power control board.**

d) A bad diode 17 will damage the power logic board. Check its resistance (Ω)* (see Figure 111) by placing the meter leads on either side of it.

e) Is the meter's numeric AND units display indicating a resistance between 500 and 1500 Ω (or between 0.50 KΩ and 1.5 KΩ)?

Yes The diode is okay. See procedure number HEATER RELAY- 2.0.1 (page 254).

No Replace the power control board (or diode 17 (1N914B)). The power logic board is probably bad also (see Figure 4A and NOTE B, page 8). After board or diode replacements continue to HEATER RELAY- 2.0.1 (page 254).

*** NOTE: The meter's diode check function will not work because the diode is 'in circuit'**

HEATER RELAY- 2.0.1 CHECK THE POWER LOGIC BOARD

a) Reconnect the X2 cable.

b) Swap in a known good power logic board (see Figure 4A and NOTE B, page 8).

c) Place the machine into Dialysis program. Does the Heater Relay alarm reoccur?

Yes Two possibilities: 1) Bad power logic board AND power control board (diode 17); 2) Bad function board.

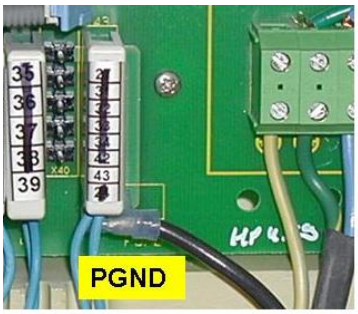
No Problem solved. The previous power logic board was bad (transistor T5).

SECTION 25 – VALVE #1 OR VALVE #2 FAIL

These procedures are used when the machine is exhibiting a "Dialyze Valve #1 Fail" OR "Act Byp Valve Fail 1" OR "Dialyze Valve #2 Fail" message.

IMPORTANT! Per Field Service Bulletin 08-FRK-003 installing the Ferrite Core (P/N 367032-05) and Cable Tie (P/N 368189-01) at the shunt door cable may remedy intermittent **Dialyze Valve #1 Failures**.

DIALYZE VALVE FAIL- 1.0.0 CHECK POWER GROUND



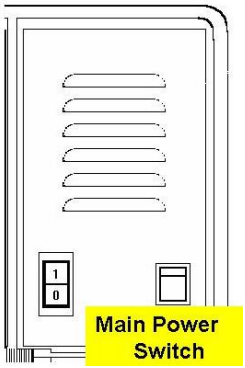
a) Turn the machine off.

b) Using a flashlight, CAREFULLY check the ENTIRE distribution board for damage and/or 'white' corrosion. **A damaged distribution board may be the problem!**

c) Referring to the Figure (right) assure the Power Ground (PGND) wire is plugged in securely and there are no signs of burning. **A loose PGND wire may be the problem!**

d) See procedure number DIALYZE VALVE FAIL- 1.0.1 (page 255).

DIALYZE VALVE FAIL- 1.0.1 CHECK GROUND RESISTANCE



a) Open the card cage and check for excessive dust or damage on the surface of the motherboard. **Motherboard damage can occur by unplugging the blood pressure module with the power on OR if there was damage at the PGND wire!**

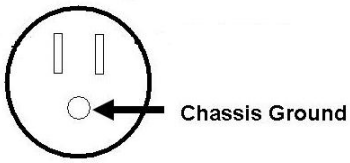
b) Referring to the Figure (right), at the rear of the machine, assure the Main Power Switch **on** (rocker switch pressed into the "1" position).

c) Referring to Figure 112 (page **Error! Bookmark not defined.**), check the 24V POWER harness was not unplugged at the rear of the motherboard (the empty pin and the orange wire should be on the left!).

d) Touch your ohm meter's leads together and subtract this resistance (Ω) reading from all subsequent resistance readings!

e) Referring to the Figure (lower, right), measure resistance between a metal portion of the **card cage** and the power plug's Chassis Ground pin.

f) Does the meter's numeric AND units display indicate less than 1.0 **Ω**?



Yes See procedure number DIALYZE VALVE FAIL- 1.0.2 (page 255).

No
a) Assure the 'green' wire is attached to the card cage and runs into the power supply.
b) Check inside the power supply to assure the green wire is connected properly.
c) If (and ONLY if) a and b are okay, the power cord or plug may be bad.

DIALYZE VALVE FAIL- 1.0.2 VERIFY PROBLEM

Valve #24's electronic circuit causes Valve #1 Fail; Valve #43's electronic circuit causes Dialyze Valve #2 Fail. Proceed accordingly:

- **Dialyze Valve #1 Fail:** See procedure number DIALYZE VALVE FAIL- 2.0.0 (page 256).
- **Act Byp Valve Fail 1:** See procedure number DIALYZE VALVE FAIL- 2.0.0 (page 256).
- **Dialyze Valve #2 Fail:** See procedure number DIALYZE VALVE FAIL- 3.0.0 (page 256).

DIALYZE VALVE FAIL- 2.0.0 CHECK VALVE #24

a) **ASSURE** valve #24 is plugged into distribution board position labeled "V24" or "P24" properly.

b) **IMPORTANT!** Turn the machine off and open the card cage.

c) Place a meter's ground (black) lead at chassis ground (see Figure 1, page 3).

d) Referring to Figure 134 (page 256), at the top of the actuator board is a 50 pin connector (P2). The solder side of P2 is arranged in two rows. Odd numbered in the bottom row, even numbered in the top.

e) Measure resistance (Ω) at the solder (rear) side of the P2 connector at ***Pin #29*** (BOTTOM row, *eleventh pin* from the FRONT of the machine). Between 40 and 100 **Ω**?

Yes See procedure number DIALYZE VALVE FAIL- 4.0.0 (page 256).

No NOTE that VALVE #24 will be checked then see procedure number DIALYZE VALVE FAIL- 5.0.0 (page 257).

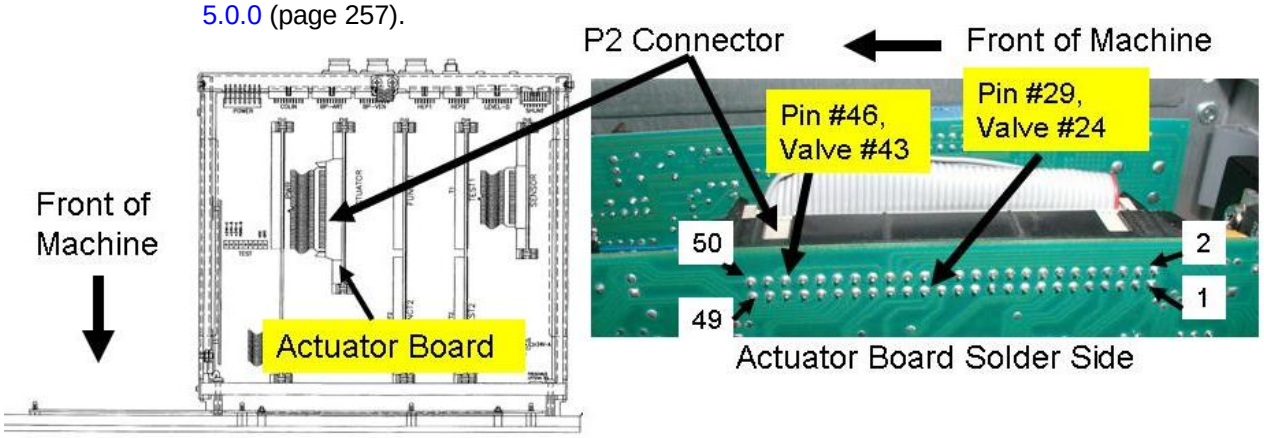


Figure 109 – Check Valve's #24 and #43 Solenoid

DIALYZE VALVE FAIL- 3.0.0 CHECK VALVE #43

a) **ASSURE** that valve #43 is plugged into distribution board position labeled "V43" or "P43" properly.

b) **IMPORTANT!** Turn the machine off and open the card cage.

c) Place a meter's ground (black) lead at chassis ground (see Figure 1, page 3).

d) Referring to Figure 134 (page 256), at the top of the actuator board is a 50 pin connector (P2). The solder side of P2 is arranged in two rows. Odd numbered in the bottom row, even numbered in the top.

e) Measure resistance (Ω) at the solder (rear) side of the P2 connector at ***Pin #46*** (TOP row, *third pin* from the front of the machine). Between 40 and 100 **Ω**?

Yes See procedure number DIALYZE VALVE FAIL- 4.0.0 (page 256).

No NOTE that VALVE #43 will be checked then see procedure number DIALYZE VALVE FAIL- 5.0.0 (page 257).

DIALYZE VALVE FAIL- 4.0.0 ISOLATE THE ACTUATOR BOARD

a) Turn the power off and swap in a known good actuator board.

b) Place the machine into Dialysis program. Does the error reoccur?

Yes See procedure number DIALYZE VALVE FAIL- 4.0.1 (page 257). The previous actuator board is okay.

No Problem solved. The previous actuator board is bad.

DIALYZE VALVE FAIL- 4.0.1 ISOLATE THE FUNCTION BOARD

a) Turn the power off and swap in a known good function board. Assure that EEPROM (IC2) is installed.

b) Enter Service Mode → Options → Hardware Options. Set T and C (Test and Calibration) to "Yes". Press the 'CONFIRM' key (the "x" turns blue).

c) Place the machine into Dialysis program. Does the error reoccur?

Yes Proceed accordingly:

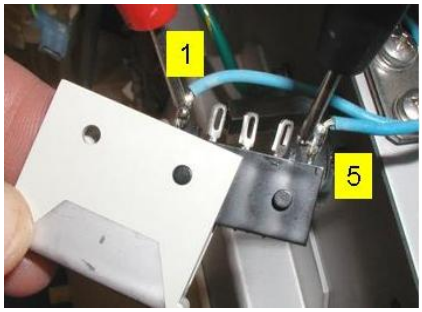
- **If the problem is intermittent:** Three checks: **1)** Per Field Service Bulletin 08-FRK-003 install the Ferrite Core (P/N 367032-05) and Cable Tie (P/N 368189-01) at the shunt door cable; **2)** One at a time swap in the other card cage boards with known good and test in between; **3)** The motherboard may be bad.
- **If the problem is occurring constantly:** Two checks: **1)** One at a time swap in the other card cage boards with known good and test in between; **2)** The motherboard may be bad.

No Problem solved. The previous actuator board is bad.

DIALYZE VALVE FAIL- 5.0.0 CHECK THE NOTED VALVE'S SOLENOID

a) Unplug the **NOTED** valve from the distribution board.

b) Using a flashlight, check **inside** the vacant position for white corrosion or damaged **male** pins. There should be five pins.



c) If the distribution board is okay, and referring to the Figure (right), open the female distribution board connector.

d) ASSURE the wires are well soldered between pins 1 and 5 (top and bottom).

e) Measure resistance (Ω) between the two wires inside the female connector **pins 1 and 5** (top and bottom),

f) Between 40 and 100 Ω?

Yes Replace the actuator cable (see Figure 4A, page 8).

No Either the valve's solenoid or its blue wiring harness is bad.

SECTION 26 - "ACT BLOOD PUMP FAILED"

ABPF- 1.0.0 CHECK 24V - C POWER SUPPLY

a) Turn the machine off for 5 seconds and back on. If (and ONLY if) the alarm reoccurs proceed.

b) **IMPORTANT! Turn the machine off!**

c) Open the card cage and place the meter's ground (black) lead at chassis ground (see Figure 1, page 3).

d) Referring to Figure 135 (page 258), assure the 24V POWER harness and all module cables are plugged securely into the motherboard.

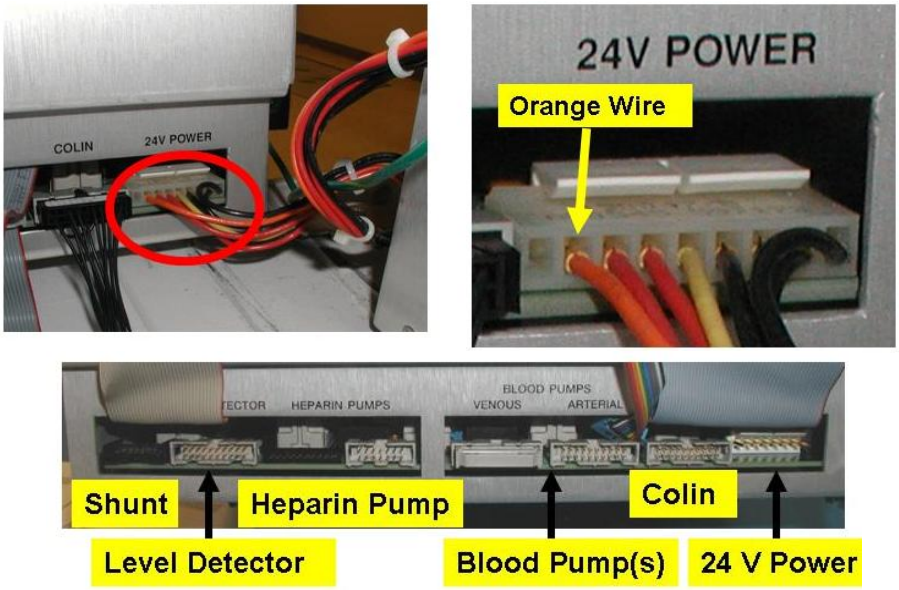
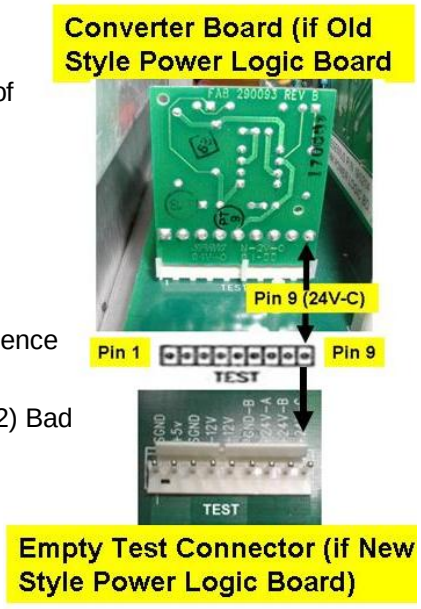


Figure 110 – Power Cable X1 / Module Cables

e) During this procedure a DC voltage (24V- C) is measured at the motherboard's TEST connector (see Figure 4A and NOTE B, page 8) depending on how the machine is equipped:

- **Equipped with old style Power Logic Board (see Figure right)**: The miniature 'Convertor board' uses the TEST connector. Place the red meter lead at the solder (rear) side of the Converter board, at *pin 9*, first pin from the right then see part f
- **Equipped with new style Power Logic Board (see Figure right):** Place the red meter lead directly at the empty TEST connector, at *pin 9,* first pin from the right then see part f

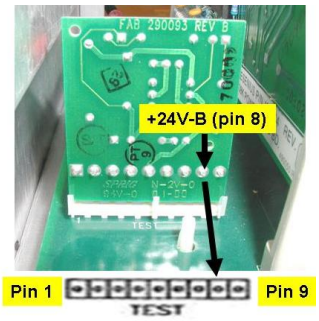


f) Turn the machine on and watch CAREULLY. Does voltage go to between 22 and 28 volts DC at any time during the power on sequence but before the alarm occurs?

Yes Three possibilities: 1) Bad Arterial Pump Ribbon cable; 2) Bad Arterial Blood Pump Module; 3) Bad Mother Board

No See procedure number ABPF- 1.0.1 (page 259).

ABPF- 1.0.1 CHECK 24V-B



a) Turn the machine off.

b) Referring to the Figure (right), place the red meter lead at TEST connector, *pin 8* second pin from the right

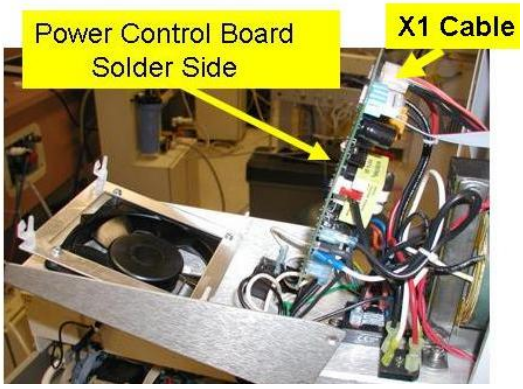
c) Turn the machine on and watch CAREFULLY. Does voltage go to between 22 and 28 volts DC at any time during the power on sequence but before the alarm occurs?

Yes See procedure number ABPF- 1.0.2 (page 259).

No Proceed to page **212**, SECTION 24 – TROUBLESHOOTING POWER DISTRIBUTION.

ABPF- 1.0.2 CHECK POWER CONTROL BOARD OUTPUT

The following checks are to be performed during the power on sequence up until the point the Alarm occurs.



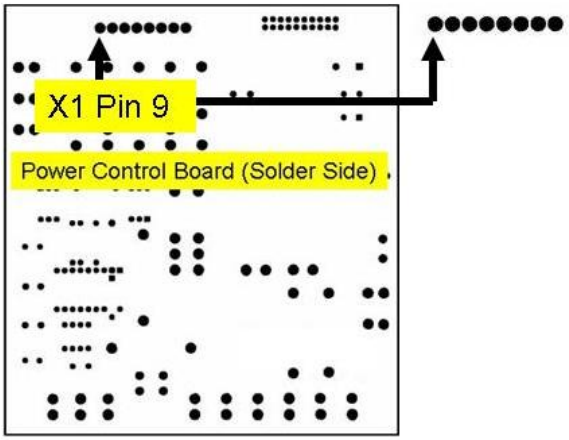
a) Turn the machine off and **UNPLUG** it. **CAUTION! Electrocution hazard if not unplugged!**

b) Slide the power supply away from the cabinet. Inside is the power control board where the power cable (X1) terminates.

c) ASSURE ALL cables are plugged in securely at the top of the power control board. **If NOT this may be the problem!**

d) Referring to the Figure (right), remove the board from its four plastic clips and remove the two **front** screws.

e) Lay the rear panel down to access to the rear (solder) side of the board power control board.



f) Plug the machine in. **CAUTION! High voltage now present!**

g) Referring to the Figure (right), place a meter lead at the rear (solder) side of the X1 connector at *pin 9* (far left).

d) Turn the machine on and watch carefully. Between 20 and 29 volts DC at any time during the power up sequence before the Alarm occurs?

Yes Bad Power Cable X1 (see Figure 135, page 258).

No Bad Power Control Board.

APPENDIX A TARGET DEAERATION PRESSURES PER GEOGRAPHICAL AREA

Elevation	Approx. atmospheric pressure	Minimum target deaeration pressure relative to atmospheric pressure
feet	mmHg	inches of Hg
0	760	-24.0
1000	728	-23.0
2000	697	-22.0
3000	667	-21.0
4000	639	-20.0
5000	612	-19.0
6000	585	-18.5
7000	561	-17.5
8000	537	-16.9
9000	514	-16.2
10000	492	-15.5

CITY	FT. ELEVATION	CITY	FT. ELEVATION
Albuquerque, NM	5,311	Little Rock, AR	257
Atlanta, GA	1,010	Los Angeles, CA	97
Atlantic City, NJ	7	Louisville, KY	477
Baltimore, MD	148	Memphis, TN	258
Bismarck, ND	1,647	Miami, FL	7
Boise, ID	2,838	Milwaukee, WI	672
Boston, MA	15	Minneapolis, MN	834
Buffalo, NY	705	Nashville, TN	590
Burlington, VT	332	New Orleans, LA	4
Charleston, SC	40	New York, NY	132
Chicago, IL	658	Norfolk, VA	24
Cleveland, OH	777	Oklahoma City, OK	1,285
Concord, NH	342	Omaha, NE	997
Dallas, TX	551	Philadelphia, PA	5
Denver, CO	5,283	Phoenix, AZ	1,110
Des Moines, IA	938	Pittsburgh, PA	1,137
Detroit, MI	633	Portland, ME	43
Hartford, CT	169	Portland, OR	21
Helena, MT	3,828	Providence, RI	51
Honolulu, HI	7	Reno, NV	4,404
Houston, TX	96	St. Louis, MO	535
Indianapolis, IN	792	Salt Lake City, UT	4,221
Jackson, MS	291	San Francisco, CA	8
Jacksonville, FL	26	Seattle, WA	400
Kansas City, MO	1,014	Springfield, MO	1,268
Las Vegas, NV	2,020	Washington, DC	10
Little Rock, AR	257	Wilmington, DE	74

APPENDIX B CALIBRATE IF REPLACED

During the process of servicing a machine, components may need to be replaced. The following table shows calibrations that must be conducted after replacing certain components. The ***Refer to:*** column is the appropriate section in the 2008K Calibration Procedures booklet (P/N 507296).

Replaced Component	Then Calibrate	Refer to:
- Deaeration Pump Head	- Deaeration & Loading Pressure	Sec. 2.2.1
- Deaeration Motor (or rebuild)		
- Loading Pressure Relief Valve		
- Flow Pump Head	- Flow Pressure	Sec. 2.2.2
- Flow Motor (or rebuild)		
- Flow Pressure Relief Valve		
- Balance Chamber	- Balance Chamber Volume	Sec. 2.2.3
- Acid Pump	- Acid Pump Volume	Sec. 2.2.4
- Bicarbonate Pump	- Bicarbonate Pump Volume	Sec. 2.2.5
- UF Pump	- UF Pump Volume	Sec. 2.2.6
- Dialysate Pressure Transducer	- Dialysate Pressure	Sec. 2.3.3
- Temperature Sensor	- Temperature Control	Sec. 2.3.6
- Heater Bar		
- Blood Leak Detector	- Blood Leak	Sec. 2.3.7
- Functional Board (New EEPROM)	- All Calibrations	All Sections
- Sensor Board	- Arterial Pressure	Sec. 2.3.1
	- Venous Pressure	Sec. 2.3.2
	- Dialysate Pressure	Sec. 2.3.3
	- Temperature Control	Sec. 2.3.6
	- Temperature Sensors	Sec. 2.3.4
	- Post Temperature Sensor	Sec. 2.3.5
	- Blood Leak	Sec. 2.3.7
	- Conductivity	Sec. 2.3.8
	- Arterial Pump Rate	Sec. 2.4.3
	- Venous Pump Rate	Sec. 2.4.4
- Blood Pump Module	- Arterial Pressure	Sec. 2.3.1
	- Arterial Pump Rate	Sec. 2.4.3
- Level Detector Module	- Venous Pressure	Sec. 2.3.2
	- Level Detector	Sec. 3.2
New Actuator/Test Board	**Voltage Detection**	**Sec. 2.4.2**

APPENDIX C BLOOD PUMP ERROR CODES

Alarm Code	Cause	Solution
A.11	Pump is not reaching speed.	Check or replace in the following order: • Rotor Hall Sensor • LP955 • LP956
A.13	Pump rotor is turning in the wrong direction.	Check or replace in the following order: • Rotor Hall Sensor • LP955 • LP956
A.16	Key stuck or held in too long.	Check or replace in the following order: • User holding key too long • BP Keypad • LP955 • LP956
A.20	Set speed-read back analog voltage at X348/14 is out of limits (set speed).	Check or replace LP955.
A.22	Arterial pressure-read back analog voltage at X348/7 is out of limits.	Check or replace LP955.
A.24	Optical sensor frequency (tach) not in range.	Check or replace in the following order: • Motor/Tachometer Assy. • LP955 • LP956
A.25	Pressure increases too quickly when the Level Up key is pressed.	Check or replace in the following order: • Vent Valve • LP955 • LP956
A.26	Pressure was adjusted too much in calibration mode.	Check or replace in the following order: • Pre/Post Pump set wrong • LP955
A.27	Timeout when receiving Intel-Hex-line or overflowed receive buffer.	Check or replace LP955.
A.28	Error in received Intel-Hex-line.	Check or replace LP955.
A.29	Pump rotor turning when it should not be (first revolution).	Check or replace in the following order: • Rotor Hall Sensor • LP955 • LP956

Error Code	Cause	Solution
E.01	EPROM CRC error.	Check or replace LP955.
E.02	Flash ROM CRC error.	Check or replace LP955.
E.03	RAM check error.	Check or replace LP955.
E.04	Reference Voltage error.	Check or replace LP955.
E.05	Serial EEPROM error.	Check or replace LP955.
E.06	Watchdog timeout.	Check or replace LP955.
E.07	+ 12 volts is outside the allowable range of 10.8 to 13.2 volts.	Check or replace in the following order: • Machine voltage (+12V) • Ribbon cable from machine • LP955
E.08	+ 24 volts is outside the allowable range of 22.8 to 28.0 volts.	Check or replace in the following order: • Machine voltage (+24V) • Ribbon cable from machine • LP955
E.09	- 12 volts is outside the allowable range of -9.6 to -13.2 volts.	Check or replace LP955.
E.10	+ 5 volts is outside the allowable range of 4.75 to 5.25 volts.	Check or replace LP955.
E.14	50 ms time period exceeded.	Check or replace LP955.
E.15	Software task was not completed correctly.	Check or replace LP955.
E.23	Pump rotor turning when it should not be (second revolution).	Check or replace in the following order: • Rotor Hall Sensor • LP955 • LP956

RED LED

The large red LED is next to the blood pump display. It will light if the door is open longer than the preset time of 15 or 30 seconds. This is set using dip-switch 4 on the LP955 board. The default setting is 30 seconds.

LED	Cause	Solution
RED LED LIT	Pump door is open longer than 30 seconds.	Check or replace in the following order: • Door Hall Sensor • LP955 • LP956

Note: Additional Blood Pump Dip-Switch settings can be found in the Arterial Pressure Calibration section of the 2008K Calibration Procedures booklet (P/N 507296).